

EXHIBIT 17

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MICROSOFT CORPORATION,

Petitioner,

v.

TS-OPTICS CORPORATION,

Patent Owner.

PTAB Case No. IPR2025-00767

Patent No. 7,266,055

**DECLARATION OF MASUD MANSURIPUR, PH.D., IN SUPPORT OF
PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 7,266,055**

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I. INTRODUCTION

1. My name is Masud Mansuripur. I am currently a professor of Optical Sciences, and the Chair of Optical Data Storage, at the University of Arizona.

2. I have been engaged by Perkins Coie LLP as a consultant in connection with *Inter Partes* Review of U.S. Patent No. 7,266,055 (the “’055 Patent”).

3. I understand that the ’055 Patent has been assigned to TS-Optics Corporation (“TS-Optics”). TS-Optics is also referred to as the “Patent Owner” in this declaration.

4. This declaration is based on the information currently available to me. To the extent that additional information becomes available, I reserve the right to continue my investigation and study, which may include a review of documents and information that may be produced, as well as testimony from depositions that not yet been taken.

II. QUALIFICATIONS AND EXPERIENCE

5. I have been involved in the optical data storage industry for over 40 years as a graduate student, research scientist, professor, author, inventor, technical advisory board member, entrepreneur and mentor. My focus has been in various subfields of classical optics, optical data storage, and optical communication, as well as several other areas of modern science and technology.

6. I received a Ph.D. in Electrical Engineering from Stanford University in 1981. I also have a Master of Science degree in Mathematics from Stanford University in 1980, a Master of Science degree in Electrical Engineering from Stanford University in 1978, and a Bachelor of Science degree in Electrical Engineering from Arya Mehr University of Technology (Iran) in 1977.

7. While a graduate student at Standard University from 1978 to 1981, I worked as a consultant for Xerox Palo Alto Research Center (PARC), and also worked at Xerox Research Centre of Canada as a member of research staff. At Xerox, I was involved in developing a rewritable optical disk for massive storage of digital information.

8. After receiving my Ph.D. degree from Stanford University, I joined the College of Engineering at Boston University, where I established a research program in optical data storage, starting as an Assistant Professor (1982–1986) and then as an Associate Professor (1986–1988).

9. In 1988, the College of Optical Sciences at the University of Arizona invited me to join their newly established Optical Data Storage Center, which was funded by the industry (IBM, Kodak, Philips-Dupont, Siemens), and by the State of Arizona. Since 1988, I have worked as a Professor of Optical Sciences at the University of Arizona, devoting my time to teaching, mentoring, and research.

10. I have been a technical advisor and/or have served on the advisory boards of several optics companies over the past 25 years. I am also a member of the International Advisory Committee of the Instrument Technology Research Center (National Applied Research Laboratory), Taiwan (2008-present). These companies and organizations engage (or were engaged) in developing advanced optical technologies including (but not limited to) optical data storage media and drives.

11. I am also the Founder and President of MM Research, Inc. (www.mmresearch.com), a company that develops and provides simulation software as well as consulting services for the optics and optical data storage industries since 1992.

12. I am a fellow of Optica (formerly the Optical Society of America or OSA), a fellow the International Society for Optics and Photonics (SPIE), and have served as a Chair, Director, or Member of numerous conferences and international organizations in optics and optical data storage systems. I have also authored five technical books, and am an inventor of 8 issued patents.

13. Additional details of my background are set forth in my curriculum vitae, attached to this declaration as Appendix A, which provides a more detailed summary of my education, work experience, publications, and teaching history.

A. Materials Reviewed

14. My opinions expressed in this declaration are based on documents and materials identified in this declaration, including the '055 patent, the prior art references and background materials discussed in this declaration, and the other references specifically identified in this declaration. I have considered these materials in their entirety, even if only portions are discussed here. Non-exclusive materials that I have relied on include the documents that I reference in this declaration and the following list of exhibits.

Exhibit	Description
Ex. 1001	U.S. Patent No. 7,266,055 B2 (“’055 patent”)
Ex. 1003	Korean Patent Appl. Pub. No. 2001-0038068A to Choi et al. (“Choi”)
Ex. 1004	Japanese Patent Appl. Pub. No. H4-113524A to Ogata (“Ogata”)
Ex. 1005	U.S. Patent Appl. Pub. No. 2003/0007430 A1 to Ikeda et al. (“Ikeda”)
Ex. 1006	Japanese Patent Appl. Pub. No. 11-203697A to Kamata (“Kamata”)
Ex. 1007	U.S. Patent No. 6,344,936 to Santo (“Santo”)
Ex. 1008	U.S. Patent Appl. Pub. No. 2003/0067848 A1 to Kabasawa et al. (“Kabasawa”)
Ex. 1009	Japanese Patent Appl. Pub. No. JP2000123386A to Miura (“Miura”)
Ex. 1010	Japanese Patent Appl. Pub. No. JP200118269A to Sugiyama (“Sugiyama”)
Ex. 1011	Prosecution File History of ’055 Patent
Ex. 1012	U.S. Patent No. 7,817,505

Exhibit	Description
Ex. 1013	U.S. Patent No. 7,065,774
Ex. 1014	U.S. Patent Publication No. 2008/0285423
Ex. 1015	U.S. Patent No. 5,561,648
Ex. 1016	U.S. Patent No. 7,369,335
Ex. 1017	European Patent Application No. EP 1,675,111 A2

15. I have also relied on my own experience and expertise in optical disk drives and optical data storage and retrieval systems.

B. Level of Ordinary Skill in the Art

16. I am not an attorney and offer no legal opinions. I have been informed about certain aspects of the law for purposes of my analyses and opinions.

17. I understand that in analyzing questions of invalidity and infringement, the perspective of a person of ordinary skill in the art (“POSITA”) is often implicated, and the Court may need assistance in determining that level of skill.

18. I understand that the claims and written description of a patent must be understood from the perspective of a POSITA. I have been informed that the following factors may affect the level of skill of a POSITA: (1) the educational level of the inventor; (2) the type of problems encountered in the art; (3) the prior-art solutions to those problems; (4) the pace of innovation; (5) the sophistication of the technology; and (6) the educational level of active workers in the field. A person of ordinary skill in the art is also a person of ordinary creativity in the art.

19. Based on my experience with packaging design technologies, as well as my reading of the '055 patent, it is my opinion that a person of ordinary skill with respect to the subject matter of the '055 patent at the time of the alleged priority date of the '055 patent in June 2003 would have had (i) a bachelor's degree in mechanical or electrical engineering and (ii) two to five years of industry experience in designing optical storage devices, disk drives or in a similar field. In this description of a POSITA, additional education could be substituted for experience and vice versa. For example, an advanced degree relating to the mechanical design of storage systems, including optical storage devices and drives, could substituted for industry experience in a related field and vice versa.

20. I am at least a person of ordinary skill in the art and was so on the date to which the '055 patent claims priority. As shown by my qualifications, I am aware of the knowledge and skill possessed by a person of ordinary skill in the art at the time of the priority date of the '055 patent. In performing my analysis, I have applied the standard set forth above.

C. Summary of Opinions

21. I have reviewed and analyzed the '055 patent.

22. Based on my review and analysis, it is my opinion that claims 1-8, 10-15, 17, 19, 21, 23-24, 26, 28, 36-38, 40-45 of the '055 patent are invalid based on the following grounds:

Ground	Basis	Reference(s)	Challenged Claims
1	§ 103	Choi	1-4, 7-8, 10-13, 15, 40
2	§ 103	Choi + Ogata	1-4, 7-8, 10-13, 15, 40, 43-45
3	§ 103	Choi + Ogata + Santo	41-42
4	§ 103	Choi + Ikeda	7, 8
5	§ 103	Choi + Ogata + Ikeda	40, 43-45
6	§ 103	Choi + Ogata + Santo + Ikeda	41-42
7	§ 103	Ogata + Kamata	36-38
8	§ 103	Kabasawa alone or in view of AAPA	17, 21, 23-24, 28
9	§ 103	Miura (alone or in view of AAPA) + Kamata	17, 19, 23-24, 26
10	§ 103	Sugiyama alone or in view of AAPA	1, 3-4, 10, 12-13
11	§ 103	Sugiyama (alone or in view of AAPA) + Kabasawa	5-6, 14

III. OVERVIEW OF THE TECHNOLOGY

A. Priority Date of the Claims

23. I have been informed that a U.S. patent application may claim the benefit of the filing date of an earlier patent application if the earlier patent application disclosed each limitation of the invention claimed in the later-filed U.S. patent application. I have also been informed that priority is determined on a claim-by-claim basis so that certain claims of a patent may be entitled to the priority date of an earlier-filed patent application even if other claims of the same patent are not entitled to that priority date.

24. I have also been informed that a patented claim is invalid if the claimed invention was patented, described in a printed publication, or in public use, on sale, or otherwise available to the public before the effective filing date of the claimed invention, or the claimed invention was described in an issued patent or a published patent application that was effectively filed before the effective filing date of the claimed invention.

25. I understand that the '055 patent claims a priority to the Korean Application No. 10-2003-0035305, filed on June 2, 2003. Ex. 1001, front page. My analysis in this declaration assumes that the priority date of the '055 patent is June 2, 2003.

B. Overview of the '055 patent

26. The '055 patent is titled “Optical Pickup Actuator and Optical Disk Drive Using the Same and Method,” and was filed on May 20, 2004. It claims priority to the Korean Patent Application No. 10-2003-0035305 filed on June 2, 2003. Ex. 1001, Front page. The optical pickup actuator described in the '055 patent includes a blade holding an objective lens and is supported on a base by a plurality of suspension wires, a pair of magnetic elements on the base, and a number of coils – focusing, tracking and tilt coils. Ex. 1001, Abstract. Figure 3 of the '055 patent describes a disk drive that includes a spindle motor 51 and an optical pickup 53 positioned on a mainframe 50. The '055's description related to

Figure 3 reads: “The spindle motor 51 rotates the disc D, and a turntable 55 on which the disc D rests is coupled with a rotary axis of the spindle motor 51. The optical pickup 53 records information on, or reproduces information from, the disc D by emitting light onto the disc D through the objective lens 56. The optical pickup 53 is positioned on the base 54 to reciprocate along the guide shaft 52 in a radial direction of the disc D.” Ex. 1001, 6:4-11. In my opinion, the general description of the optical disk drive in connection with Figure 3 is nothing new and it merely explains the configuration of conventional disk drives that were very well-known to a POSITA at the time of the ‘055 patent’s priority date.

27. The main embodiment of the ‘055 patent is shown in Figure 4, with Figures 5 through 7 illustrating different views and/or features of the Figure 4 embodiment. Figure 8 shows an alternate embodiment. Ex. 1001, 5:43-55; Figures 4-8.

28. Referring to Figure 4, the actuator in Figure 4 includes a base 100, a blade 110, yokes 171 and 190, and a pair of magnets 180. Ex. 1001, 6:23-38. The actuator also includes first coils 130 (tilt coils), second coils 140 (tracking coils) and third coils 150 (focusing coils) that are positioned on the blade 110. Ex. 1001, 6:39-40. The third coils 150 may be vertically divided into a plurality subcoils (e.g., two subcoils as shown in Figure 4). Ex. 1001, 6:55-57; FIG. 4.

FIG. 4

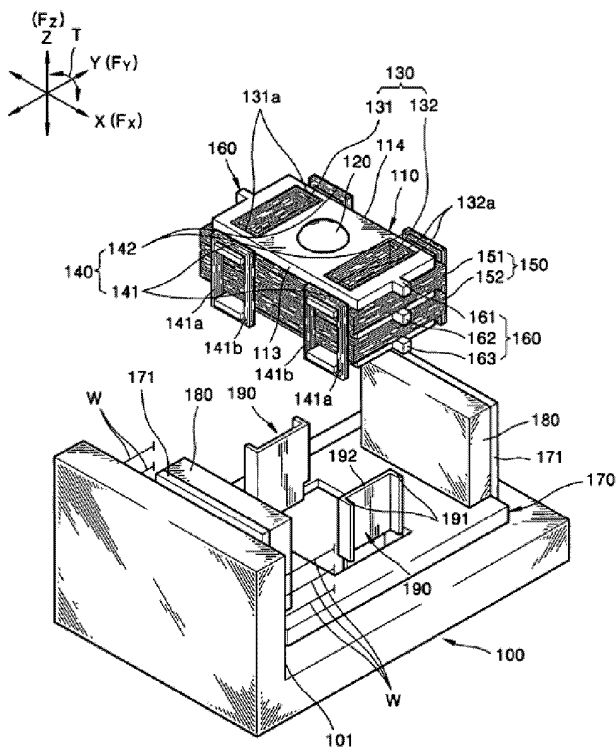
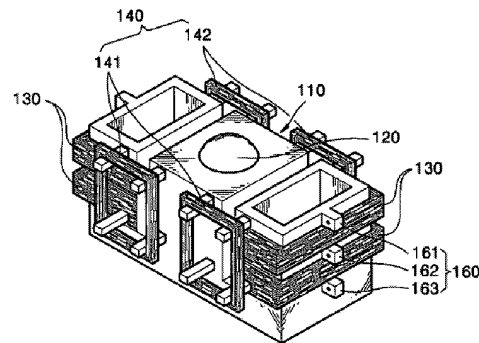


FIG. 8



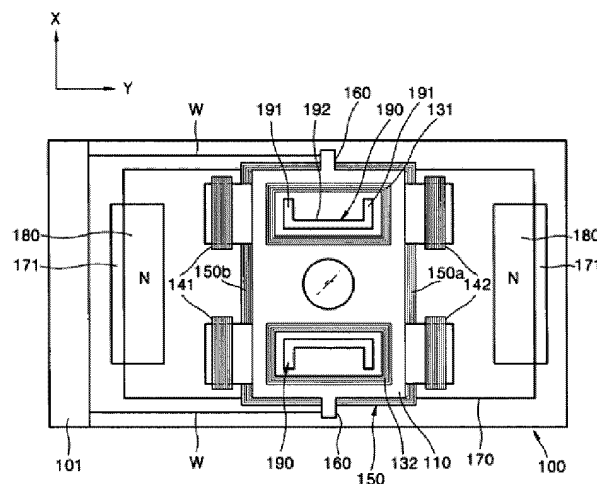
29. “The first coil 130 is positioned horizontally on the blade 110 and includes a pair of coils 131 and 132 positioned in an X direction (first direction) symmetrically with respect to the objective lens 120. The second coil 140 is disposed on either one or two sides 113 and 114 in the Y direction (second direction) of the blade 110 (i.e., opposite the magnets 180) to generate an electromagnetic force in tracking direction a X due to interaction with the magnets 180. The second coil 140 is positioned vertically on either one or two sides 113 and 114 of the blade 110 and includes coils 141 and 142 positioned on the two

sides 113 and 114 symmetrically with respect to the objective lens 120, respectively.” Ex. 1001, 6:40-52.

30. The '055 patent describes three optical pickup actuator configuration types that include: “(a) focus and tracking coils, (b) focus and tracking coils, of which the focus coil also serves as a tilt coil, or (c) focus, tracking, and tilt coils. The type of optical pickup actuator according to aspects of the invention is dependent on whether the optical pickup actuator includes the third coil 150 and whether the first coil 130 serves as focus and/or tracking coils.” Ex. 1001: 7:4-11.

31. The '055 patent further describes a pair of inner yokes 190 that are positioned on the base 100, where each inner yoke includes a straight sidewall 192 and a pair of bent sections 191. Ex. 1001, 7:49-54; Figure 5.

FIG. 5



32. “The inner yoke 190 is disposed opposite the outer yoke 171 to create a magnetic path. A pair of first walls 191 are disposed to face the second coil 140 and separated from each other in the Y direction (second direction). A second wall 192 extending along the Y direction (second direction) is attached to the pair of first walls 191.” The ’055 patent explains that the addition of the pair of walls 191 to the end of second wall 192 in the inner yokes increases an effective area facing the magnet 180 and improves the sensitivity in tilt and tracking directions compared to inner yokes that do not have the pair of first walls 191. Ex. 1001, 7: 64-8:54.

33. The ’055 patent has 45 claims, 8 of which are independent claims.

C. Prosecution History

34. The ’055 patent was filed on May 20, 2004, and originally included 47 claims. Ex. 1011, 208-285. In an Office Action, dated January 5, 2007, claims 1-7, 11-16, 19, 20 and 25-27 were rejected under 35 U.S.C. § 102(b) as being anticipated by Korean Patent 2002-140828, claims 32-47 were allowed, and dependent claims 8-10, 17, 18, 21-24 and 28-31 were objected to for being dependent upon a rejected base claim but were considered allowable if rewritten to include all of their base claim limitations. *Id.*, 167-170. In response, Applicant amended claims 1 and 11 to include the limitations of claims 2 and 12, respectively, and argued against the anticipation rejections. *Id.*, 151-163.

35. A Notice of Allowance was issued on April 27, 2007, which did not provide a specific reason for allowance. *Id.*, 142-146. Subsequently, Applicant filed an information disclosure statement (IDS) on June 29, 2007 (*id.*, 23-28); the '055 patent issued on September 4, 2007. After issuance, Applicant filed a certificate of correction to delete “to” that appeared after “each” in column 12, line 41 in claim 21. *Id.*, 9-10.

D. The Challenged Claims

36. Claims 1-8, 10-15, 17, 19, 21, 23-24, 26, 28, 36-38, 40-45 of the '055 patent are being challenged.

E. Claim Construction

37. I understand that claim terms generally are construed in accordance with the ordinary and customary meaning they would have to a POSITA at the time of the invention in light of the claim language, the specification, and the prosecution history. I understand that dictionaries and other extrinsic evidence may be considered as well, though such evidence is typically regarded as less significant than the intrinsic record in determining the meaning of the claim language.

38. For all terms of the challenged claims of the '055 patent, I have interpreted them as they would have been understood by a POSITA at the time of the priority date of the '055 patent.

39. It is my opinion that there are no terms that require construction to address this petition, and I rely on their ordinary and customary meaning as outlined in paragraph 37 above.

IV. UNPATENTABILITY OF THE '055 PATENT CLAIMS

A. Standards for Invalidity

1. Obviousness

40. I am informed and understand that a patent cannot be properly granted for subject matter that would have been obvious to a person of ordinary skill in the art at the time of the alleged invention, and that a patent claim directed to such obvious subject matter is invalid under 35 U.S.C. § 103. It is also my understanding that in assessing the obviousness of claimed subject matter, one should evaluate obviousness in light of the prior art from the perspective of a person having ordinary skill in the art at the time the alleged invention was made (and not from the perspective of either a layman or a genius in that art). It is my further understanding that the question of obviousness is to be determined based on several factors that include:

- The scope and content of the prior art;
- The difference or differences between the subject matter of the claim and the prior art (whereby in assessing the possibility of obviousness

one should consider the manner in which a patentee and/or a Court has construed the scope of a claim);

- The level of ordinary skill in the art at the time of the alleged invention of the subject matter of the claim; and
- Any relevant objective factors (the “secondary indicia”) indicating nonobviousness, including evidence of any of the following: commercial success of the products or methods covered by the patent claims; a long-felt need for the alleged invention; failed attempts by others to make the alleged invention; copying of the alleged invention by others in the field; unexpected results achieved by the alleged invention; praise of the alleged invention by the alleged infringer or others in the field; the taking of licenses under the patent by others and the nature of those licenses; expressions of surprise by experts and those skilled in the art at the subject matter of the claim; and whether the patentee proceeded contrary to accepted wisdom of the prior art.

41. I also understand that, at least in IPR proceedings, admissions in the patent or in the prosecution file history of the patent (Applicant Admitted Prior Art or “AAPA”) can be used to establish background knowledge possessed by a POSITA, to furnish a motivation to combine, to assess whether a patent’s claims would have been obvious, and/or to supply a missing limitation.

V. OBVIOUSNESS OF CHALLENGED CLAIMS

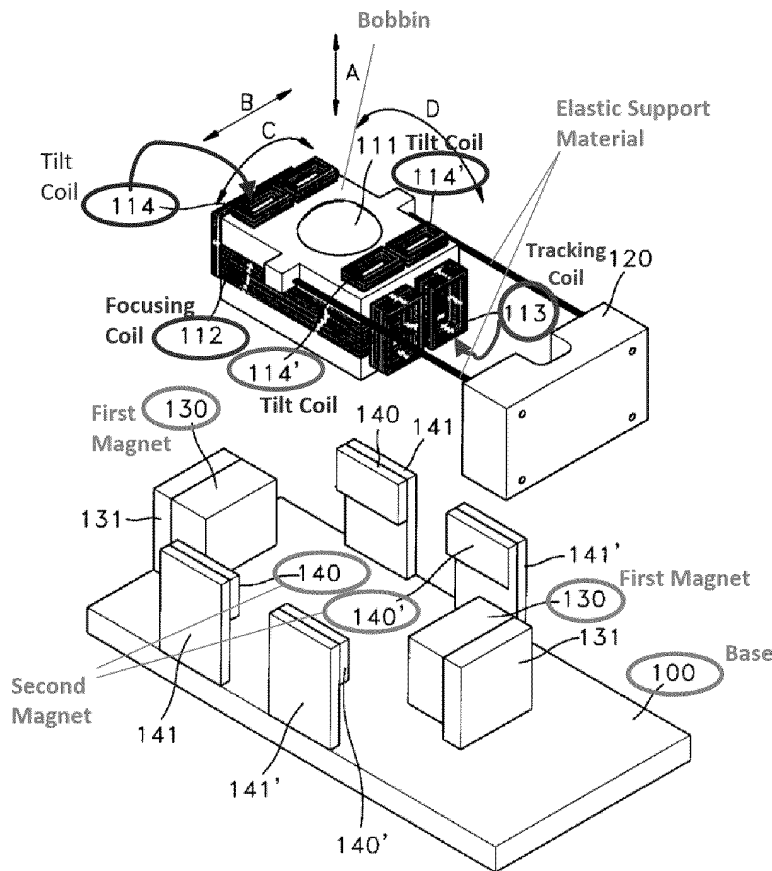
A. Ground 1: Choi Renders Obvious Claims 1-4, 7-8, 10-13, 15 and 40

42. I have reviewed the Choi reference. In my opinion, it teaches or suggests every limitation of claims 1-4, 7-8, 10-13, 15 and 40. Below are my opinions regarding elements these claims.

1. Brief Description of Choi (Ex. 1003)

43. Choi is a Korean patent application publication titled “Optical Pickup Assembly,” which was published on May 15, 2001. Choi describes an optical pickup assembly that includes “a bobbin equipped with an objective lens, an elastic support material to elastically and movably support the bobbin on a holder fixed to a predetermined base, a focus coil and tracking coil installed on the bobbin to form an electric current path for driving the focus and tracking direction of the objective lens, a tilt coil installed on the bobbin to form a conduction path for tilt driving the objective lens, a plurality of magnets and yokes to generate electromagnetic force that drives the objective lens along with the current flowing through each coil.” Choi, Abstract. Choi’s configuration allows performing a stable tilt control. *Id.*

44. Choi’s Figure 9 has been annotated by Petitioner to show an example optical pickup assembly according to its second embodiment. Choi, 43.



**Figure 9 of Choi
(annotated)**

45. The optical pickup assembly of Figure 9 includes a base (100), a bobbin (110) that accommodates an objective lens (111) and is positioned on the base (100). Choi, 51-81, 131-135, 162-171. The optical pickup assembly also includes a focusing coil (112) and tracking coils (113) that drive the objective lens (111) in the focusing direction (A) and tracking direction (B). *Id.* The base (100) includes a set of first magnets (130) and yoke (131) that interact with the current flowing through the focusing coils (112) and tracking coils (113). *Id.* The optical

pickup assembly also includes tilt coils (114, 114') that drive the objective lens (111) in the direction of arrows (C, D) via interaction between the current flowing through the tilt coils (114, 114') and a second set of magnets (140, 140'). Choi, 142-144, 166-170.

46. Choi further explains that objective lens (111) is elastically and movably supported on the holder (120) by an elastic support material (121). Choi, Abstract, 93-95, 122-127, 182-186.

2. Claim 1:

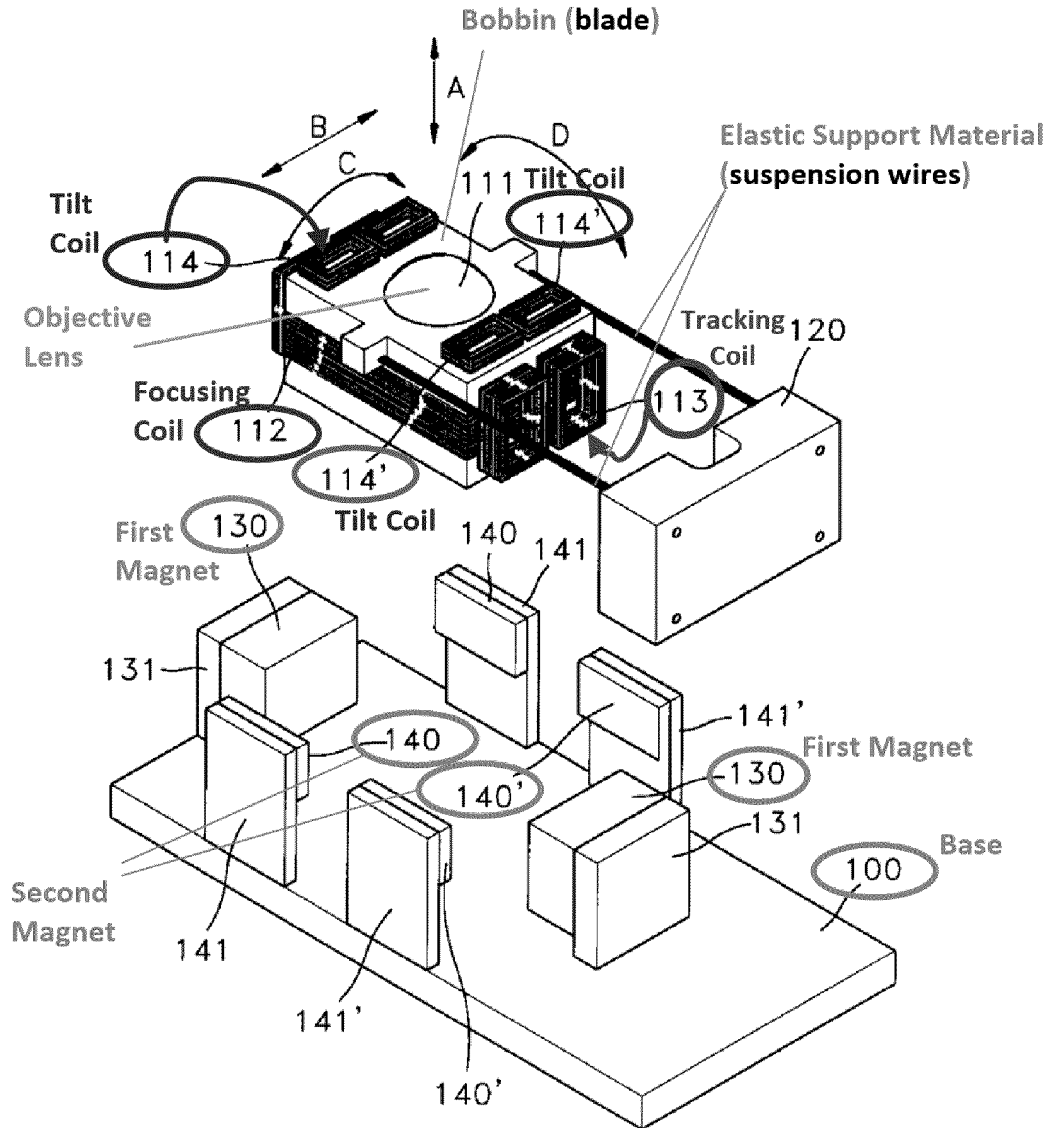
a. 1[pre]¹: “An optical pickup actuator for use with an objective lens on a base, comprising:”

47. Choi discloses the preamble limitations because is describes an optical pickup assembly (Choi, Abstract), and further illustrates “an exploded perspective view of *an optical pickup assembly*² according to a second embodiment of the [] invention” in its Figure 9. Choi, 47; Figure 9. Choi’s optical pickup assembly includes “a bobbin equipped with *an objective lens*, an elastic support material to elastically and movably support the bobbin on *a holder fixed to a predetermined base.*” Choi, Abstract. Figure 9 of Choi (annotated below) illustrates an example

¹ The claims identifiers (*e.g.*, 1[pre]) are not part of the original claims and are added to facilitate referencing those limitations in subsequent analyses.

² All bold and italicized emphases are added, unless otherwise specified.

optical pickup assembly that includes a bobbin (blade) that accommodates an objective lens (111) on a base (100).



**Figure 9 of Choi
(annotated)**

48. Choi's optical pickup assembly includes an optical pickup actuator because such an assembly includes a bobbin with focusing, tracking and tilt coils that control and adjust the position of the objective lens by moving the objective lens in the focusing (A), tracking (B) and tilting (C, D) directions. Choi, 162-170. The interpretation of Choi's optical pickup assembly components described above as an optical pickup actuator is consistent with the explanation of an optical pickup actuator in the '055 patent (Ex. 1001, 1:28-35), which describes that an actuator controls the position of an objective lens in focusing and tracking directions:

Typically, an optical pickup has an actuator for controlling the position of an objective lens in a focus and a tracking direction so that light is focused on a desired track formed onto a recording surface of the disc. The optical pickup actuator serves as a controller by constantly adjusting the distance between the objective lens and the recording surface so that the focus of a light spot is maintained and the light spot follows the desired track.

b. 1[a]: "a blade holding the objective lens;"

49. Choi discloses a blade (bobbin) that holds the objective lens (111), as shown in annotated Figure 9 (above). Choi, 131-133, 162-163, 182-186. Choi's bobbin is similar in appearance and functionality to the blade 110 that is shown and described in the '055 patent. Ex. 1001, 6:23-24, Figure 4 (element 110).

50. The '055 patent uses the term blade to refer to the element that holds the objective lens; the same lens holder allows various coils – tracking and focusing and tilt coils – to be attached to, or wound around, various sections of the lens holder/bobbin. A POSITA would have understood that the terms bobbin, blade, and lens holder were used interchangeably. See, for example, U.S. Patent No. 7,817,505 (Exhibit 1012) and U.S. Patent No. 7,065,774 (Exhibit 1013) where the term “blade” is used; see, for example, U.S. Patent Publication No. 2008/0285423 (Exhibit 1014) and U.S. Patent No. 5,561,648 (Exhibit 1015), which use “lens holder;” see, for example, U.S. Patent No. 7,369,335 (Exhibit 1016) and European Patent Application No. EP 1,675,111A2 (Ex. 1017), which use “bobbin.”

c. 1[b]: “a plurality of suspension wires supporting the blade on the base so that the blade is elastically movable;”

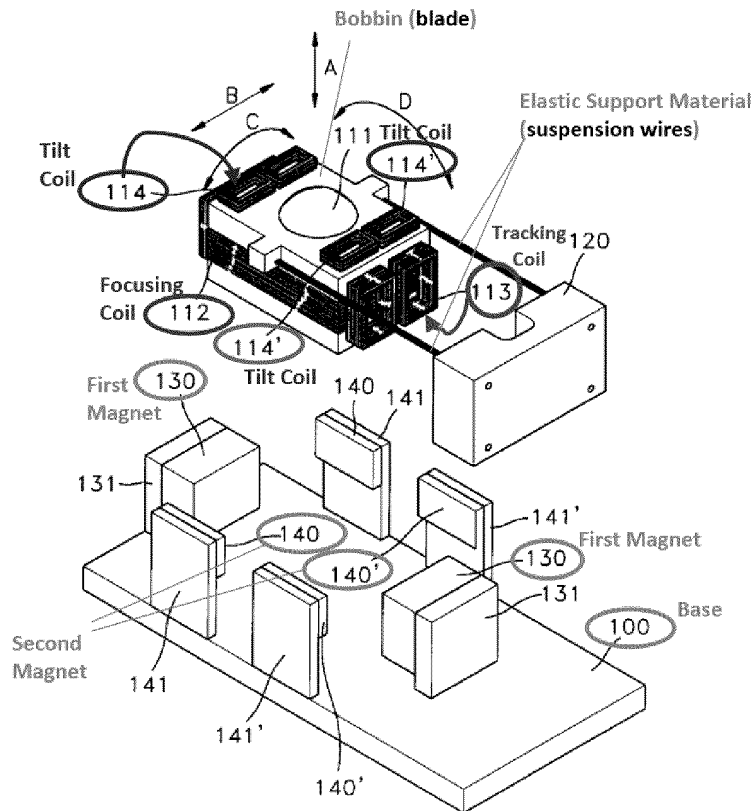
51. Choi describes a plurality of suspension wires in the form of two elastic support material (121) that “elastically and movably” support the blade on a holder (120) that is fixed to, and installed on, the base (100). Choi, Abstract, 77, 132-133. 152-153, annotated Figure 9 (above), Figure 11 (element 121). Additionally, the use of suspension wires for elastically moving the blade was nothing new and well known. The '055 patent itself described the use of suspension wires in an optical pickup actuator in connection with prior art systems

of Figures 1 and 2. Ex. 1001, 2:39-43. These are in fact applicant admitted prior art (AAPA) that further confirm this limitation was obvious to a POSITA.

d. 1[c]: “a magnetic element positioned on the base;”

52. Choi describes that its optical pickup assembly includes first magnets (130) and second magnets (140, 140’), any one or a combination of which can be construed as the claim 1 magnetic element. Choi’s magnets are positioned on the base (see Figure 9, illustrating the magnets are attached to yokes 131, 141, 141’ that are on the base 100) and interact with the current flowing through the focusing (112), tracking (113) and tilt (114) coils to move the objective in focusing, tracking and tilt directions. Choi, 142-144, 167-171, Figure 9 (annotated below); see also *id.*, 133-144.

DECLARATION OF MASUD MANSURIPUR, PH.D.
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 7,266,055



**Figure 9 of Choi
(annotated)**

53. The '055 patent similarly describes “a magnetic element” encompasses one or more magnetic elements, namely, “*a pair* of magnets 180” that interact with the focus coil (150) and/or tilt coils (130). Ex. 1001, 6:25-27; Figures 4, 5 and 7. Reading claims 7 and 8 also confirms this interpretation because those claims each state: “the magnetic element comprises *a pair* of unipolar magnets.” Ex. 1001, 11:13-20. Therefore, the magnetic element in claim 1 can be more than a single element.

e. 1[d]: “a coil positioned horizontally on the blade to

generate an electromagnetic force in a focusing and/or tilting direction through an interaction with the magnetic element;”

54. Choi describes this limitation because it discloses that its optical pickup assembly includes a focusing coil (112) that interact with first magnets (130) to move the blade in the focusing direction (Choi, 133-135, 162-163) and four tilt coils (114, 114') that interact with the second set of magnets (140, 140') to move the blade in tilt directions. Choi, 166-170, Figure 9 (annotated above).

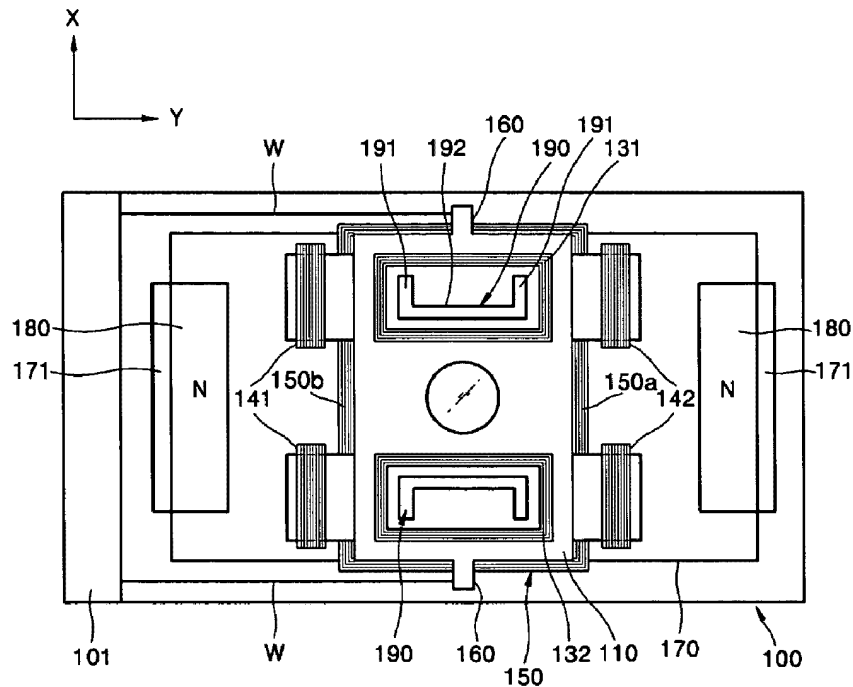
55. Both focusing coils and tilt coils of Choi are positioned horizontally on the blade because they are positioned on the blade and the direction of their windings is parallel to the top surface of the blade. Choi, Figure 9. This interpretation is consistent with how the '055 patent describes horizontally positioned coils.

56. For example, the focusing coil (150) and tilt coils (130) in connection with Figures 4 and 5 (below) are described as being positioned horizontally on the blade. Ex. 1001, 6:39-41: “First, second and third coils 130, 140, and 150, respectively, are positioned on the blade 110. The *first coil 130 is positioned horizontally on the blade;*” *id.*, 6:55-56: “The *third coil 150 is positioned to surround the outside of the blade 110 horizontally.*” In each of those cases, the coils 130 and 150 have windings that are parallel to the surface of the blade. This is in contrast to the '055 patent's description of tracking coils (second coils 140)

FIG. 4



FIG. 5



57. Additionally, each of the focusing coil and tilts coils of Choi, or a combination of them, can satisfy the claim limitation of “*a coil...* to generate an electromagnetic force in a focusing and/or tilting direction.” This interpretation is confirmed by element 1[f] (below) that recites the coil includes more than one coil (or a pair of coils): “*the coil comprises a pair of first coils.*” Ex. 1001, 10:53-55.

f. 1[e]: “wherein the coil is divided into a plurality of subcoils, where each subcoil is separated from an adjacent subcoil in a vertical direction, and;”

58. Choi describes this limitation because it discloses that its coil is divided into the following subcoils: one focusing subcoil (112), and tilt subcoils

(114, 144'). See element 1[d], above. This is shown in Figure 9 (below), where vertical separation of one of Choi's tilt subcoils from the focusing subcoil (i.e., an adjacent subcoil) is illustrated. Each of the other three tilt subcoils have a vertical separation from the focusing subcoil, and similarly, the focusing subcoil is separated from an adjacent tilt subcoil in the vertical direction.

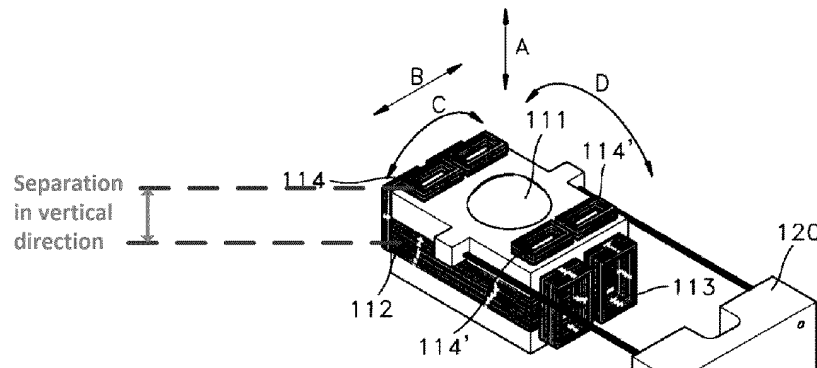


Figure 9 (partial)

g. 1[f]: “wherein the coil comprises a pair of first coils positioned on the blade in a first direction and facing each other with respect to the objective lens.”

59. Choi describes this limitation because its coil included a pair of tilt coils (114, 114') that were positioned on the blade, facing each other with respect to the position of the objective lens (111). Choi, 164-167: “... tilt coils 114 and 114' are installed symmetrically on the upper surface of the bobbin 110.... the tilt coils 114 and 114' are installed on both sides.”

60. To help with the illustration, a cartesian coordinate system has been added to the Figure 9 below, which is annotated to identify directions A, B and E.

Choi's Figure 9 originally showed only directions A and B. As shown in the annotated Figure 9 (below), Choi's pair of tilt coils (114, 114') (a pair of first coils) are on the blade in the E-direction (first direction).

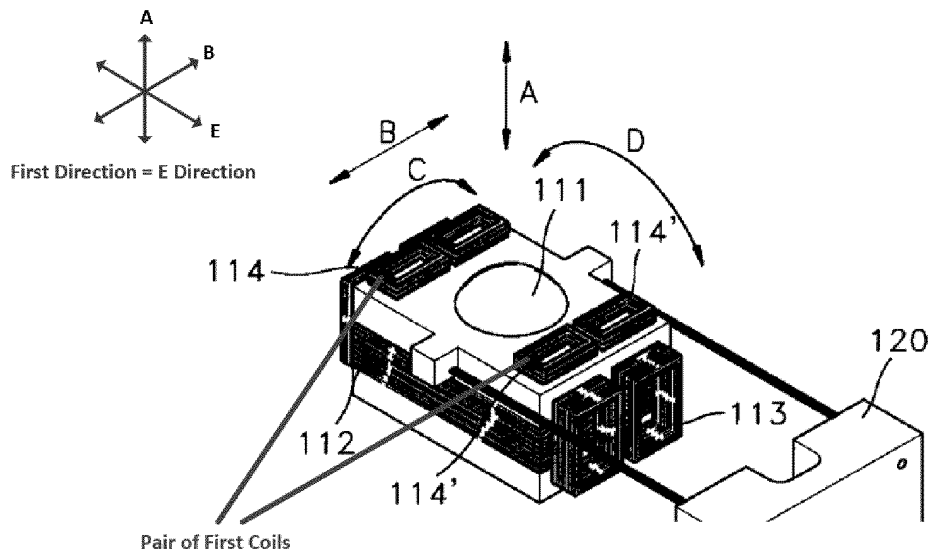
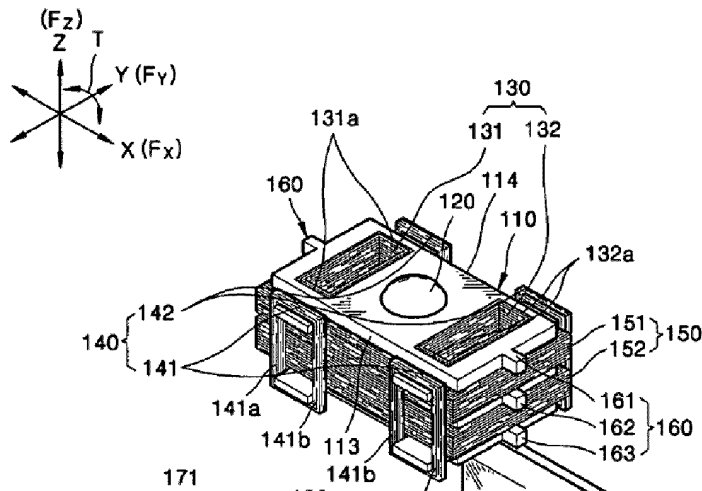


Figure 9 (partial)
(annotated to include coordinate system)

3. Claim 2: “The optical pickup actuator according to claim 1, wherein the coil comprises a coil surrounding an outer surface of the blade.”

61. Choi's actual pickup actuator includes a focusing coil (112) that wraps around the side surfaces (outer surface) of the bobbin (blade). Choi, 52, 133-134, Figure 9, element 112. This is consistent with the '055 patent that explains (and shows in Figure 4 – reproduced below) a focusing coil 150 surrounds the outside of the blade: “The third coil 150 is positioned to surround the outside of the blade 110 horizontally.” Ex. 1001, 6:55-56; Figure 4.

FIG. 4



- 4. Claim 3: “The optical pickup actuator according to claim 1, further comprising a second coil positioned vertically on a side of the blade in a second direction substantially perpendicular to the first direction, the second coil generating an electromagnetic force in a tracking direction through interaction with the magnetic element.”**

62. Choi discloses the claimed second coil as tracking coils (113) that are positioned vertically along the sides of the blade. As illustrated in annotated Figure 9, the tracking coils 113 (second coils) are positioned vertically on a side of the blade (bobbin 110), in a second direction (B direction) that is perpendicular to the first direction (E direction). More specifically, Choi’s tracking coils (113) include two pairs of subcoils, each pair is positioned vertically on one sidewall of the blade; the vertically-placed pair of subcoils (113) are separated in the second (or B) direction, which is perpendicular to the first (or E) direction.

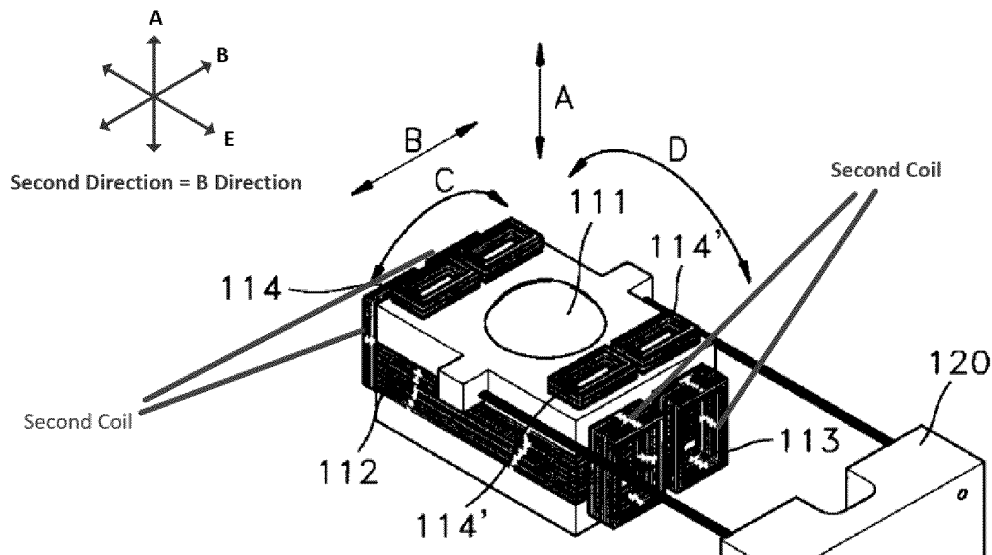


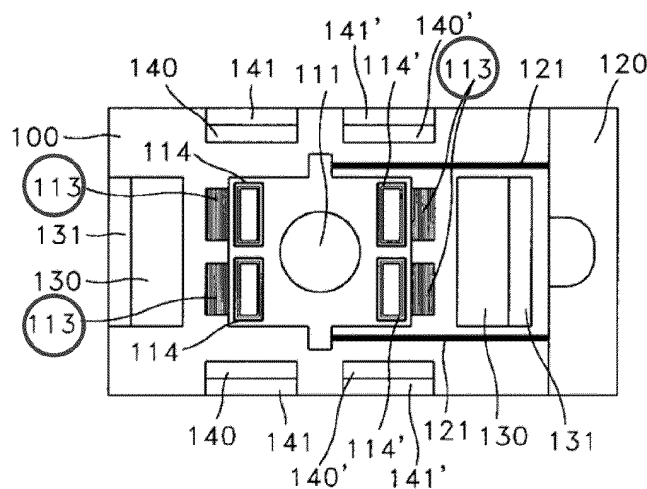
Figure 9 (partial)
(annotated to include coordinate system)

63. Choi also described that “the second coil generat[es] an electromagnetic force in a tracking direction through interaction with the magnetic element,” which is required by the claim. In particular, Choi describes the interaction of the tracking coils (113) (second coil) with the magnets (130) effectuates tracking control: “... the bobbin 110 is equipped with a focusing coil 112 and *a tracking coil 113* for driving the objective lens 111 in the focusing direction (A) and *tracking direction (B)*; the base 100 is equipped with *a first magnet 130* and a first yoke 131 *for interaction with the current flowing through the coils 112 and 113.*” Choi, 132-135, 182-186.

64. Choi further teaches or suggests that such an interaction “generate[s] electromagnetic force that drives the objective lens along with the current flowing through each coil.” Choi, 124-125. A POSITA would have understood and found it obvious that Choi’s tracking coils generate an electromagnetic force in the tracking direction because, as their name implies, those coils drove the objective lens in the tracking direction through the interaction between the current flowing through those coils and the magnetic element.

5. Claim 4: “The optical pickup actuator according to claim 3, wherein the second coil is positioned on both sides of the blade.”

65. Choi’s tracking coils (113) (second coil) are positioned on both sides of the bobbin (Choi, 131-135), as shown in annotated Figure 9 (above), and also illustrated in annotated Figure 11 (below).

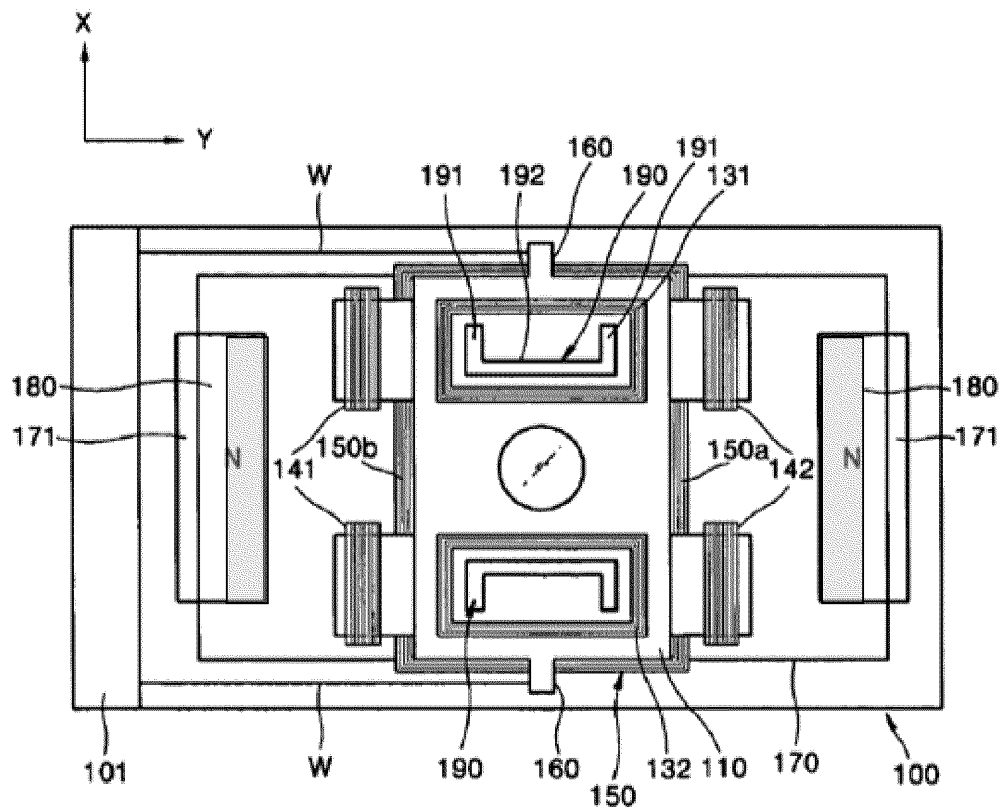


**Choi's Figure 11
(annotated)**

6. Claim 7: “The optical pickup actuator according to claim 1, wherein the magnetic element comprises a pair of unipolar magnets disposed opposite each other with respect to the blade and have the same polarity.”

66. Claim 7 (and a few others in the '055 patent) recites a (pair of) unipolar magnet(s). But it would have been obvious to a POSITA (which had some level of experience and/or education in this area) that this claim limitation is describing unipolar interaction with the magnet(s), and not a “unipolar” magnet itself, as I explain below.

67. A true unipolar magnet does not exist, and all magnets are bipolar, which means the magnet has a north pole and a south pole. In the context of optical pickup actuators, a unipolar magnet refers to using the magnet in such a way that only one pole – either north or south (but not both) – faces and interacts with a particular coil. This type of unipolar interaction is also described in the '055 patent's description, where in Figure 5 (annotated below), magnetic element 180 is positioned such that only its north pole (N) is facing, and interacting with, coils 141 and 142. Ex. 1001, 6:19-54.



**Figure 5 of '055 patent
(annotated)**

68. While Figure 5 does not annotate the south (S) pole of magnets 180 perhaps because its illustration was not relevant to the magnetic interaction, Figure 2 of the '055 patent (below), which also shows a unipolar interaction, more clearly labels both the north and south poles of magnets (22a, b). Notably, the north pole of magnets 22a, 22b are facing coils 12a, and 12b, respectively, and interact with those coils. Ex. 1001, 1:36-37, 1:48-52.

69. Figure 2 also shows a bipolar interaction, where magnets 21a and 21b are positioned such that both their north and south poles face, and interact with, coils 11a, and 11b. *Id.*

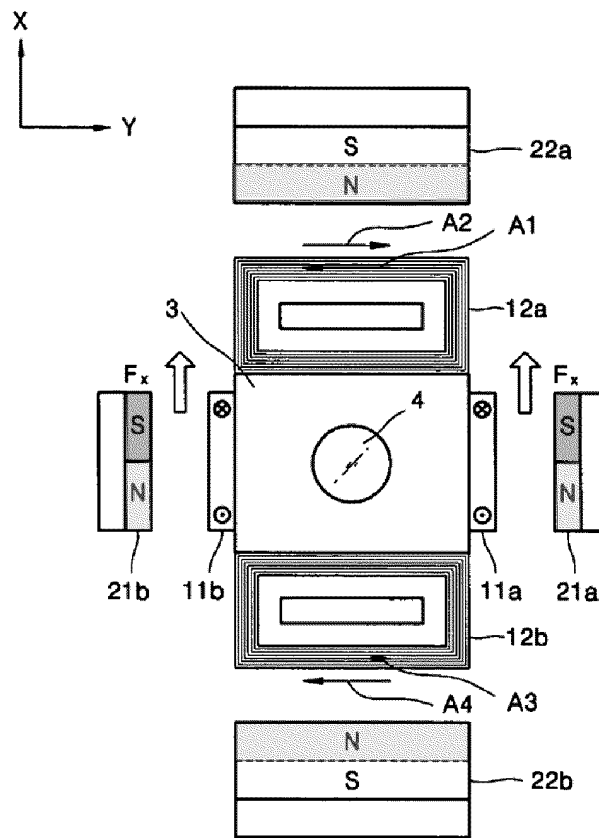


Figure 2 of '055 patent
(annotated)

70. Based on the description of the '055 patent, and its own knowledge, a POSITA would have understood that the recitation of a pair of unipolar magnets in claim 7 refers to unipolar interaction of the magnets with the coil(s) facing those magnets.

71. Getting back to Choi, a POSITA would have understood that Choi's magnets (130) were a pair of magnets that interacted with the focusing coil (112) in a unipolar manner. In particular, Choi's focusing coil (112) completely wraps around the blade; when the focusing coil (112) is energized, the action of the magnetic field of magnets (130) on the electric current of the coil produces an electromagnetic force.. To move the bobbin in the focusing direction (A-direction), both ends of the bobbin must move either up or down, and this is possible only when the same polarity (either both N, or both S poles) of magnets (130) faces the coil (112).

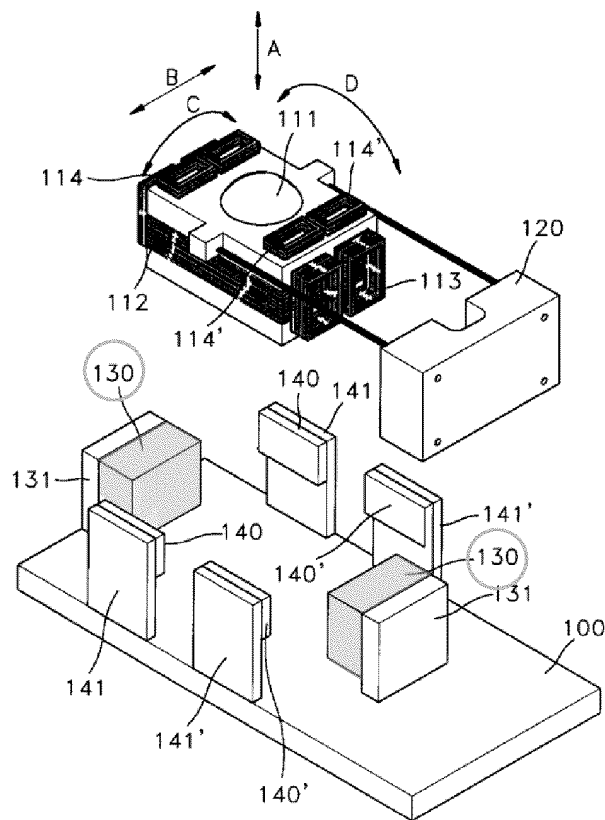
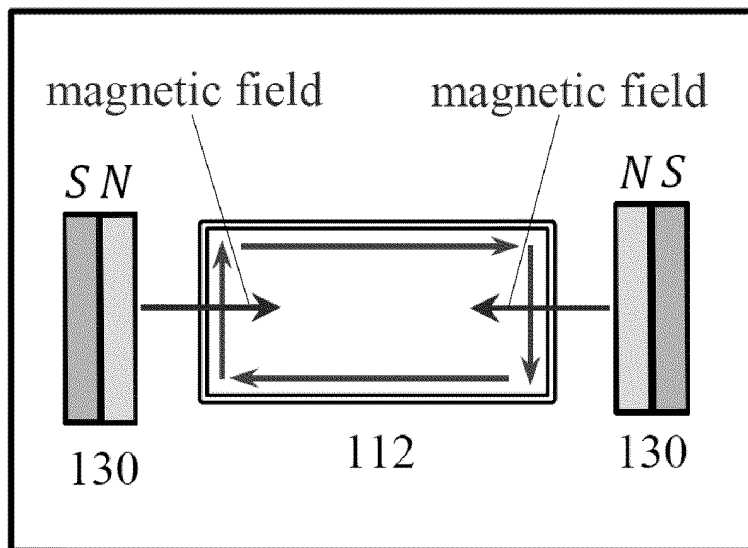


Figure 9
(annotated)

72. The below figure (prepared by Petitioner) further illustrates the principles behind unipolar interaction between the focusing coil (112) and magnets (130), and why the two magnets 130 of Choi must be “unipolar”³ and have the same polarity (i.e., both north poles facing the coils 112, and 113, or both south poles facing these coils).

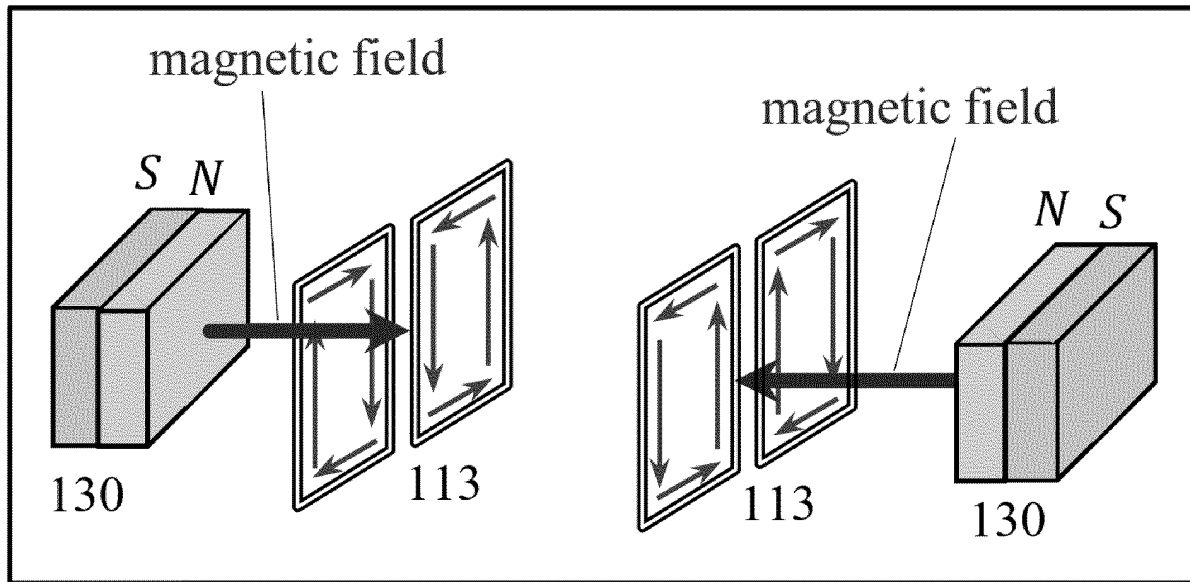
³ I will use the term “unipolar” magnet for simplicity, but as I explained above, the unipolar refers to the magnetic interaction, and not the magnet itself.



**Illustrative Figure – Focus Coil Interaction
(Prepared by Petitioner)**

73. As shown by blue arrows, the two legs of the focusing coil 112 facing the magnets 130 carry their electrical currents in opposite directions relative to each other. The unipolar magnets 130 thus exert a Lorentz force on the magnet-adjacent legs of the coil 112 in the same direction (either both up or both down); this up/down direction is depicted as direction A in Choi's Figure 9. Depending on the sense of the current in coil 112 (i.e., either clockwise or counterclockwise), the Lorentz force acting on coil 112 will move the bobbin 110 either up or down, in the direction of focusing (marked as direction A in Choi's Figs. 9 and 10). This will only happen when the same pole of "unipolar" magnets 130 is facing the focus coil 112.

74. While not necessary to consider the magnetic interaction with other coils for the purposes of claim 7, the use of “unipolar” magnets would also allow the proper magnetic interactions with the tracking coils 113 of Choi, as I explain with the help of the figure below.



**Illustrative Figure – Tracking Coil Interaction
(Prepared by Petitioner)**

75. When using the “unipolar” magnet as shown in the above figure, the currents flowing within the adjacent pair of subcoils 113 mounted on each facet of the bobbin must flow in opposite directions (i.e., one flowing clockwise, the other counterclockwise). In this way, the Lorentz force of magnets 130 acting on the vertical legs of the subcoils 113 (i.e., those legs that are located near the centers of the opposite facets of the bobbin) will cooperate to move the bobbin along the same tracking direction (i.e., B direction depicted in Choi’s Figs. 9 and 10). To

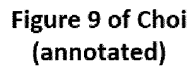
reverse the direction of tracking motion along the arrow B, all four currents in the four subcoils 113 must be simultaneously reversed.

76. Therefore, a POSITA would have understood, and/or would have found it obvious, that Choi's magnets 130 were "unipolar" magnets, and would have produced the required interactions with focusing 112 and tracking 113 coils.

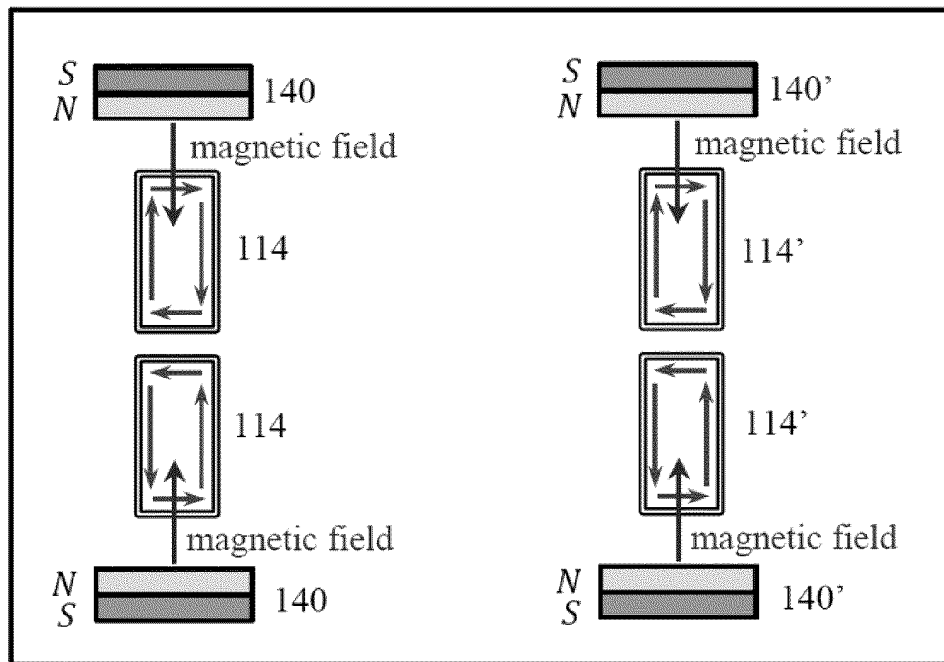
7. Claim 8: "The optical pickup actuator according to claim 3, wherein the magnetic element comprises a pair of unipolar magnets disposed opposite each other with respect to the blade in the second direction and have the same polarity."

77. Choi teaches or suggests implementing unipolar interaction between its tilt coils (114, 114') with magnets (140, 140') which were disposed in the B-direction (second direction). See annotated Figure 9 of Choi below. In particular, Choi explains the interaction between the tilt coils and magnets: "the interaction between the *current flowing in the tilt coils 114 and 114' and the magnetic force generated by the second magnets 140 and 140'* and the second yoke 141 and 141' *causes the tilt operation to be implemented in the directions of arrows C and D.*"

Choi, 168-170.



79. The below figure (prepared by Petitioner) further illustrates the principles behind unipolar interaction between tilt coils (114, 114') and magnets (140, 140') of Choi.



**Illustrative Figure – Tilt Coil Interaction
(Prepared by Petitioner)**

80. Suppose both magnets 140 (placed on opposite sides of the bobbin 110) have the same N polarity facing the tilt coils 114, as shown in the figure above. Then the currents in the two subcoils 114 must be in opposite directions—one clockwise, the other counterclockwise, as shown in the figure above—so that the force of the magnetic field acting on these coils would cause them to tilt the bobbin in the *C* direction depicted in Figure 9 of Choi. A similar argument applies to the magnets 140' and the corresponding tilt coils 114'. Assuming that both (unipolar) magnets 140' have the same N polarity facing the tilt coil 114', then the currents in the 114' coils must also be in opposite directions to each other in order to tilt the bobbin in the same *C* direction. Note in the figure above that the currents

of the subcoils 114' have the same directions as those in the corresponding subcoils 114.

81. It must be pointed out that, in principle as well as in practice, one could select any one of N or S poles of the four magnets 140 and 140' to face the corresponding tilt subcoils 114, because each of these four magnets is responsible for generating a Lorentz force only on a single subcoil of 114 and 114'. In other words, whether each of the four poles facing the bobbin is a north pole or a south pole is immaterial, because the direction of the current in each magnet-adjacent subcoil can be chosen to coordinate the tilt motion of the bobbin in response to the forces acting on the four sub-coils. But each of the magnets must be in a unipolar configuration, i.e., either its north pole or its south pole (but not both poles) must face a corresponding tilt subcoil 114. A POSITA would have understood, and would have found obvious, this aspect of Choi's magnets 140 and 140'.

82. In other words, a POSITA had only two obvious choices in selecting the polarity of the pair of "unipolar" magnets 140 and 140': (1) the same polarity to face the tilt coils (as shown in the above illustration, the north polarity), or (2) opposite polarities to face the tilt coils (e.g., one unipolar magnet with its N pole would face the first subcoil of 114, and the other unipolar magnet with its S pole would face the second subcoil of 114). In both scenarios, a POSITA would have known and found it obvious that the desired tilt direction could be achieved by

properly selecting the direction of the electrical current (one of two choices – either clockwise or counterclockwise) driving each of the tilt subcoils.

83. The selection of the direction of the currents in the coils, and the selection of the magnetic poles facing the coils were well known, and within the knowledge of a POSITA, and could even be done using a simple trial-and-error exercise that involved a few alternatives.

8. Claim 10:

a. 10[pre]: “An optical disc drive for a disc that is a recording medium, comprising:”

84. Choi teaches or suggests the preamble of claim 10 because it describes an optical disc drive for an optical disc, which includes an optical pickup assembly, to record on the optical disc: “... *disk players* that record and play information on disks, such as CDP (compact disk player) or DVDP (digital versatile disk player) are provided with an optical pickup assembly that *moves along the radial direction of the disk, radiates light to the disk*, receives light reflected from the disk, and *records or reproduces information*.” Choi, 91-92.

85. A POSITA would have known that an optical disc drive that Choi describes was used for either playing back or writing information on an optical disc, which is a recording medium.

b. 10[a]: “a spindle motor for rotating the disc;”

86. Choi suggests this limitation because it describes a disk player that plays or records information on an optical disc. Choi, 91-92. Optical disc drives have a spindle to allow the optical disc to rotate to enable reading or writing to the disc. A POSITA would have known or found it obvious that to rotate the spindle, a spindle motor would be commonly used. This is also confirmed by the '055 patent itself, where in the description of related art explains: “The optical disk drive includes a spindle motor that rotates a disc.” Ex. 1001, 1:23-27; see also *id.*, 3:3-8. Therefore, this limitation was also obvious as it was AAPA.

c. 10[b]: “an optical pickup for recording and/or re-producing information by emitting light onto the disc through an objective lens;”

87. Choi describes “an *optical pickup assembly* that moves along the radial direction of the disk, *radiates light to the disk, receives light reflected from the disk, and records or reproduces information.*” Choi, 91-92. Choi’s optical pickup assembly includes an objective lens, as I explained in element 1[pre], that focuses the light onto the disk for reading and/or recording information. Therefore, Choi describes, teaches and suggests element 10[b], in a similar way that is described in the '055 patent. For example, the '055 patent explains: “The optical pickup 53 records information on, or reproduces information from, the disc D by emitting light onto the disc D through the objective lens 56. The optical

pickup 53 is positioned on the base 54 to reciprocate along the guide shaft 52 in a radial direction of the disc D.” Ex. 1001, 6:6-11. Additionally, an optical pickup for recording or reproducing information was well-known in the art (see paragraph 26 above) and was admitted in the ‘055 patent as being part of the related prior art and AAPA. Ex. 1001, 1:20-31.

d. 10[c]: “an optical pickup actuator for controlling a position of the objective lens so that the emitted light is focused on a desired position of the disc, the optical pickup actuator comprising:”

88. See element 1[pre].

e. 10[d]: “a blade holding the objective lens,”

89. See element 1[a].

f. 10[e]: “a plurality of suspension wires supporting the blade on a base so that the blade is elastically movable,”

90. See element 1[b].

g. 10[f]: “a magnetic element positioned on the base, and,”

91. See element 1[c].

h. 10[g]: “a coil positioned horizontally on the blade to generate an electromagnetic force in a focusing direction and/or a tilting direction through interaction with the magnetic element,”

92. See element 1[d].

i. 10[h]: “wherein the coil is divided into a plurality of

subcoils, where each subcoil is separated from an adjacent subcoil in a vertical direction, and”

93. See element 1[e].

j. 10[i]: “wherein the coil comprises a pair of first coils positioned on the blade in a first direction so as to face each other with respect to the objective lens.”

94. See element 1[f].

9. Claim 11: “The optical disc drive according to claim 10, wherein the coil comprises a coil positioned on the blade so as to surround an outer surface of the blade.”

95. See claim 2.

10. Claim 12: “The optical disc drive according to claim 10, wherein the optical pickup actuator further comprises a second coil positioned vertically on a side of the blade in a second direction substantially perpendicular to the first direction, the second coil generating an electromagnetic force in a tracking direction through interaction with the magnetic element.”

96. See claim 3.

11. Claim 13: “The optical disc drive according to claim 12, wherein the second coil is positioned on both sides of the blade.”

97. See claim 4.

12. Claim 15: “The optical disc drive according to claim 12, wherein the magnetic element comprises a pair of unipolar magnets disposed opposite each other with respect to the blade in the second direction and have the same polarity.”

98. See Claim 8.

13. Claim 40:

a. 40[pre]: “An optical pickup actuator for use with an objective lens on a base, comprising:”

99. See element 1[pre].

b. 40[a]: “a blade holding the objective lens;”

100. See element 1[a].

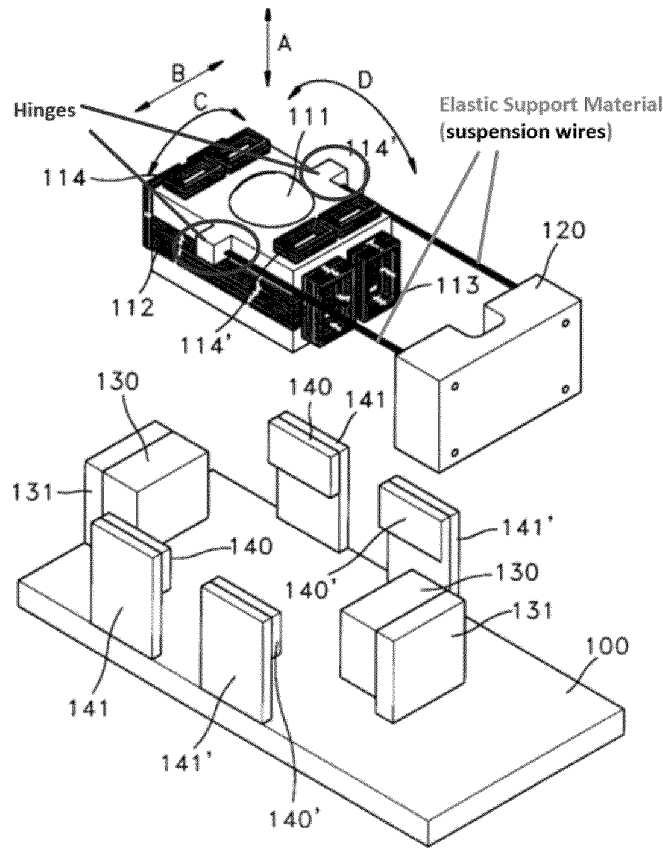
c. 40[b]: “a plurality of suspension wires movingly supporting the blade on the base;”

101. See element 1[b].

d. 40[c]: “a plurality of hinges each of [sic] coupled to an end of a suspension wire;”

102. Choi describes a plurality of hinges that allow the elastic support material (121) (suspension wires) to be attached to those hinges, as shown in annotated Figure 9 (below). Choi, 77, 132-133; Figure 4, Figure 9.

DECLARATION OF MASUD MANSURIPUR, PH.D.
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 7,266,055



**Figure 9 of Choi
(annotated)**

e. 40[d]: “a pair of unipolar magnets positioned on the base; and”

103. See claim 8. For element 40[d] in Ground 1, the magnets (140, 140') of Choi are construed as the pair of unipolar magnets that are positioned on the base.

f. 40[e]: “a plurality of coils connected to an electric circuit and interacting with the unipolar magnets to

create an electromagnet force to move the blade; and”

104. Choi tilt coils (114) are the plurality of coils that are recited in this element. A POSITA would have found it obvious based on Choi’s explanations that the tilt coils are connected to an electric circuit. For example, Choi describes driving the coils with an electric current:

... a focus coil and tracking coil installed on the bobbin *to form an electric current path for driving the focus and tracking direction of the objective lens*, a tilt coil installed on the bobbin to form a conduction path for tilt driving the objective lens, *a plurality of magnets and yokes to generate electromagnetic force that drives the objective lens along with the current flowing through each coil.*

Choi, 24-30; see also, *id.*, 181-182.

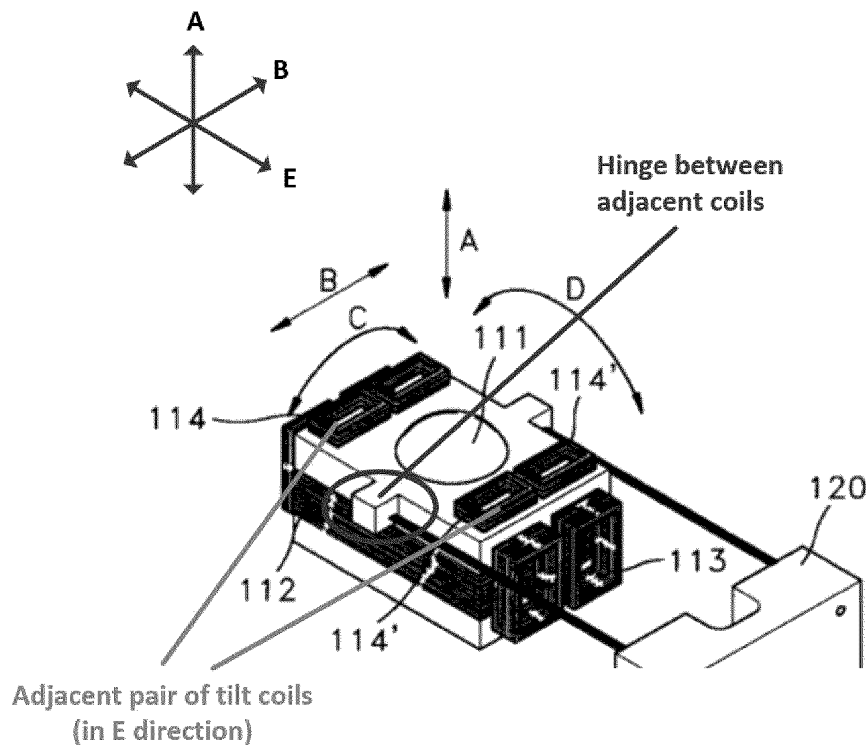
105. It was obvious and known to a POSITA to supply the coils with an electric current, and to produce a magnetic force due to the interaction between the coils and magnets. Choi further describes such interaction; for example:

That is, the *interaction between the current flowing in the tilt coils 114 and 114' and the magnetic force generated by the second magnets 140 and 140' and the second yoke 141 and 141'* causes the tilt operation to be implemented in the directions of arrows C and D.
Choi, 167-170.

g. 40[f]: “wherein at least one of the plurality of coils is divided into subcoils and a hinge coupled to each of

the plurality of suspension wires is between an adjacent pair of subcoils”

106. Choi describes that its tilt coils (114, 114') (“the coil”) are divided into subcoils (plurality of subcoils); for example, two tilt subcoils are shown in the annotated figure 9 of Choi (below), which also shows each of the two hinges that connect to the two suspension wires is positioned between two adjacent tilt subcoils (adjacent in E direction). Only one hinge and one tilt coil pair are annotated, but as can be seen in the figure, a second hinge is similarly positioned on the opposite side of the blade from the first hinge that is between another set of adjacent tilt coils.



**Figure 9 of Choi (partial)
(annotated to include coordinate system)**

**B. Ground 2: Choi in combination with Ogata Renders Obvious
Claims 1-4, 7-8, 10-13, 15, 40 and 43-45.**

107. I have reviewed the Choi and Ogata references. In my opinion, the combination of Choi and Ogata teaches or suggests every limitation of claims 1-4, 7-8, 10-13, 15, 40 and 43-45, as I explain below.

1. Brief Description of Ogata (Ex. 1004)

108. Ogata is a Japanese patent application publication titled “Lens Drive Support,” which was published on April 15, 1992. Ogata describes a lens drive support that includes “an objective lens holder having an objective lens that focuses

a light beam on an optical recording medium, and focus coils that drive the objective lens in the optical axis direction of the light beam.” Ogata, 18-20. Ogata further describes that its “focus coils are divided and arranged in the optical axis direction, and a protruding member ... is provided between each focus coil.” Ogata, 21-22.

109. Ogata describes it is beneficial to divide the prior art focus coil (60) that wrapped around the objective lens holder (see prior art Figure 5) into two subcoils that are separated from each other in the optical axis – or vertical – direction. Ogata, 84-85, Figure 1 (annotated below).

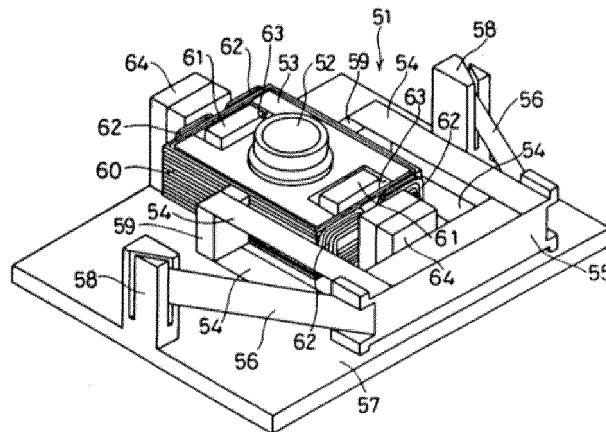


Figure 5 of Ogata (Prior Art)

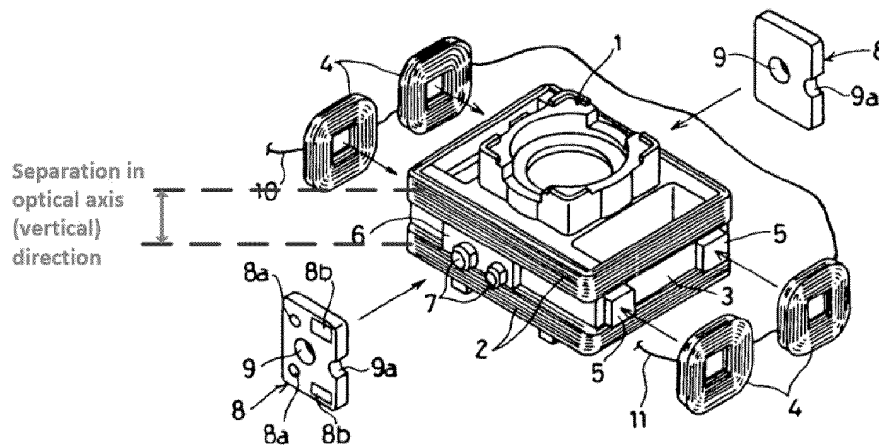


Figure 1 of Ogata (annotated)

110. Ogata explains that dividing the focus coils into two separated subcoils allows placement of protruding and standing members in the space between the subcoils, which enables easy and accurate placement of coils and relay boards without using special tools, and improves the productivity of the lens drive support. Ogata, 21-22, 66-78, 80-85, 104-108.

111. Ogata describes that the additional space between the separated focus coils allows placement of (A) radial direction drive coils (4) – i.e., the tracking coils – onto dowels (5) (Ogata, 26-27, 151-152; Figure 1) and (B) placement of relay boards (8) onto protruding elements (7) and attachment of leaf springs (12) – i.e., elastic members – thereto. Ogata, 134-136, 152-154, 160-161; Figure 4.

112. Ogata uses the terminology “radial direction coils” to identify what are normally called “tracking coils.” This is further evident from the description of Ogata, which explains its “radial coil that drives the objective lens in a direction

perpendicular to the optical axis.” Ogata, 25. In this context, optical axis is equivalent to the “focusing direction of motion” of the objective lens. Therefore, Ogata’s mention of “perpendicular to the optical axis” could refer to either radial or tangential directions at the disk surface. However, the placement of the radial direction drive coils (4) and magnets 15 in, for example, Ogata’s Figure 4, makes it clear and would convey to a POSITA that the radial direction drive coils are indeed tracking coils. Ogata, 128-130, Figure 4.

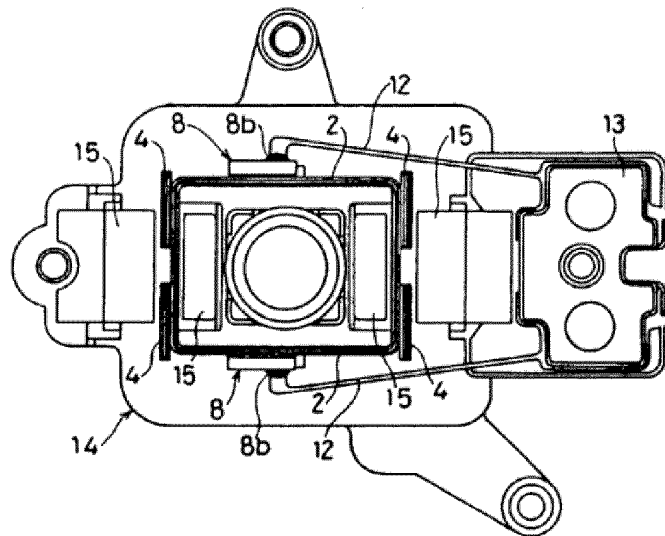


Figure 4 of Ogata

113. By providing such a configuration, Ogata explains that “each relay board 8, 8 [sic] is provided with each convex portion 7..., and each radial coil 4... is provided with each dowel 5..., so as to fit therein; therefore, *when fixating, they can be easily positioned without using a special tool, and furthermore, the accuracy of their position can be improved.*” Ogata, 170-172.

2. Motivation to Combine Choi and Ogata with a Reasonable Expectation of Success

114. A POSITA would have found it obvious and would have been motivated to combine Ogata with Choi, and specifically to use Ogata's teachings about separating the focus coils into two subcoils, for several reasons.

115. Both Choi and Ogata described optical disc drives and components related to an optical pickup using an objective lens to focus the light onto the optical disc for reading/writing information (Choi, Abstract, 91-92; Ogata, 29-31, 81-87) and both references described improvements to optical disc drives. Choi, 117-119; Ogata, 104-108, 187. Therefore, the teachings of Choi and Ogata related to the same technology area and very specifically to optical disc drive components.

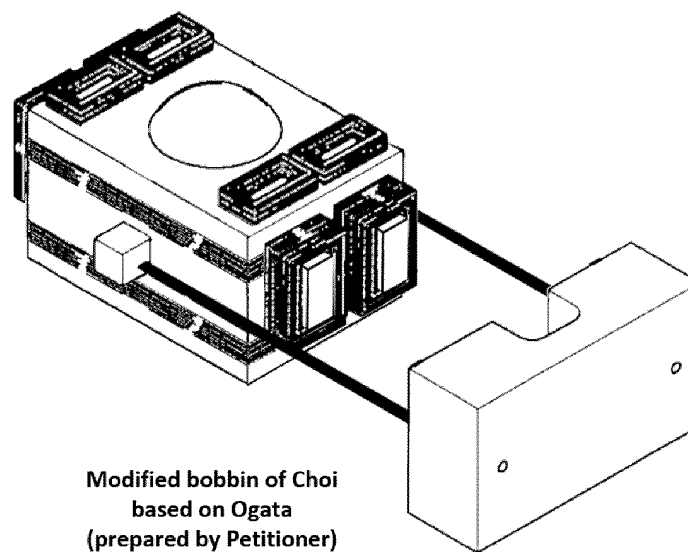
116. As explained above, Ogata's improvement included separating the focus coil into two subcoils (Ogata, 182-185), and by doing so, unlike the prior systems that placed the radial drive (tacking) coils atop the focus coils, the new configuration of Ogata's vertically separated focus subcoils provided the space that allowed placement of dowels (5) for accurate installation of tracking coils. Ogata, 170-172. Therefore, a POSITA would have been motivated to combine this teaching of Ogata with Choi to improve the ease and accuracy of installation of Choi's tracking coils (113). As Ogata explains, "with the above configuration, the assembly work of the lens drive support becomes easier than before, the assembly

time is shortened, and the performance of the assembled lens drive support becomes more constant. Furthermore, fewer tools are used during assembly operations.” Ogata, 175-176. A POSITA would have recognized these benefits, and thus would have been motivated to make this combination.

117. Third, Ogata explained that its configuration that involved using dowels in the space between the separated focus coils helped to improve the long-term usability of the optical pickup. In particular, Ogata explained that attaching another element, such as radial drive (tracking) coils to the surface of the focusing coil via an adhesive could produce an unstable bonding strength that changed over time. Ogata, 73-77. And the above-described dowels provided a stable surface for placement of tracking coils (without a need to use an adhesive), which improved the long-term stability and performance of the device. Ogata, 106-108, 176-177. Therefore, a POSITA would have been further motivated to, and found it obvious to, combine this feature of Ogata with Choi.

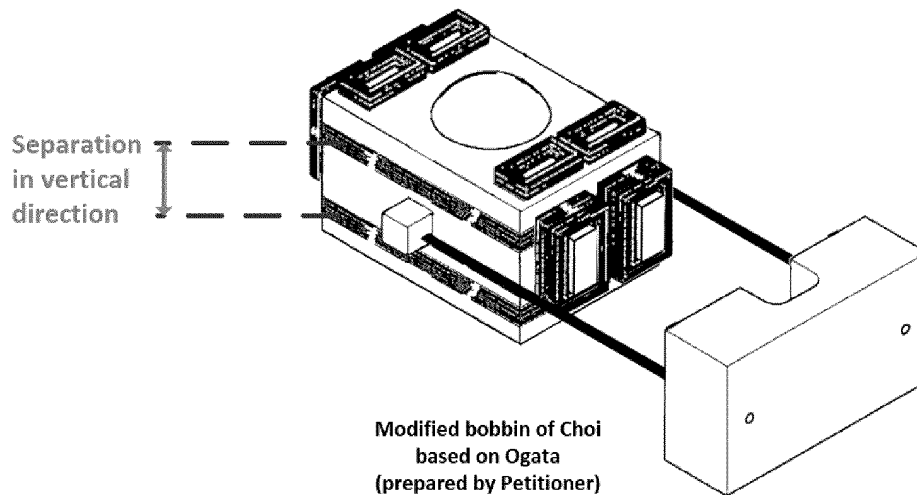
118. Modifying Choi’s optical pickup assembly to vertically divide the focus coils and to add the dowels (as described in Ogata) were simple modifications and would have been within the knowledge and capabilities of a POSITA, and it involved routine mechanical and electrical modifications. A POSITA would have been able to successfully make this combination with a very high expectation of success.

119. The following sketch provides an example of how the combined system would have looked like. Choi's focus coil (112) would have been divided into two vertically separated subcoils. Choi's optical pickup assembly would have been modified to include four dowels – similar to Ogata's dowels (5) – to accommodate Choi's tracking coils (113).



3. Claims 1 and 10:

120. Limitations 1[e]/10[h] recite: “**wherein the coil is divided into a plurality of subcoils, where each subcoil is separated from an adjacent subcoil in a vertical direction.**” The Choi-Ogata combination teaches or suggests this limitation as described above and illustrated in the below figure.



121. The remaining limitations of claims 1 and 10, in the Choi-Ogata combination are taught or suggested by Choi, as I explained in connection with Ground 1.

4. Claims 2-4, 7-8, 11-13 and 15

a. Claims 2 and 11

122. Claims 2/11 recite: “... wherein the coil comprises a coil surrounding an outer surface of the blade.” In Choi-Ogata combination, Ogata teaches that the pair of focusing coils that are vertically separated constitute the coil surrounding an outer surface of the blade, as illustrated in Ogata’s Figure 1 (below), and the above figure prepared by Petitioner that illustrates an example configuration for the combination.

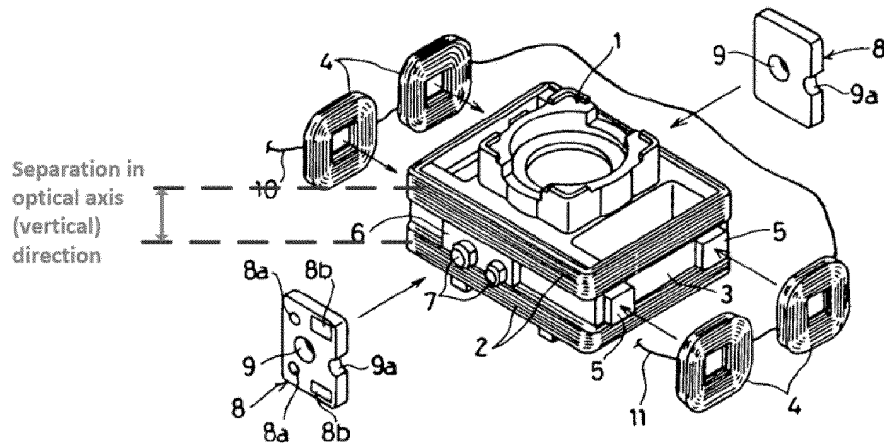


Figure 1 of Ogata (annotated)

b. Claims 3-4, 7-8, 12-13 and 15

123. See claims 3-4, 7-8, 12-13 and 15 in Ground 1.

5. Claim 40

124. In the Choi-Ogata combination, the combination of Choi and Ogata teaches or suggests elements 40[c] and 40[f], while Choi teaches or suggests the remaining elements of claim 40.

a. 40[pre]: “An optical pickup actuator for use with an objective lens on a base, comprising:”

125. See element 1[pre] in Ground 1.

b. 40[a]: “a blade holding the objective lens;”

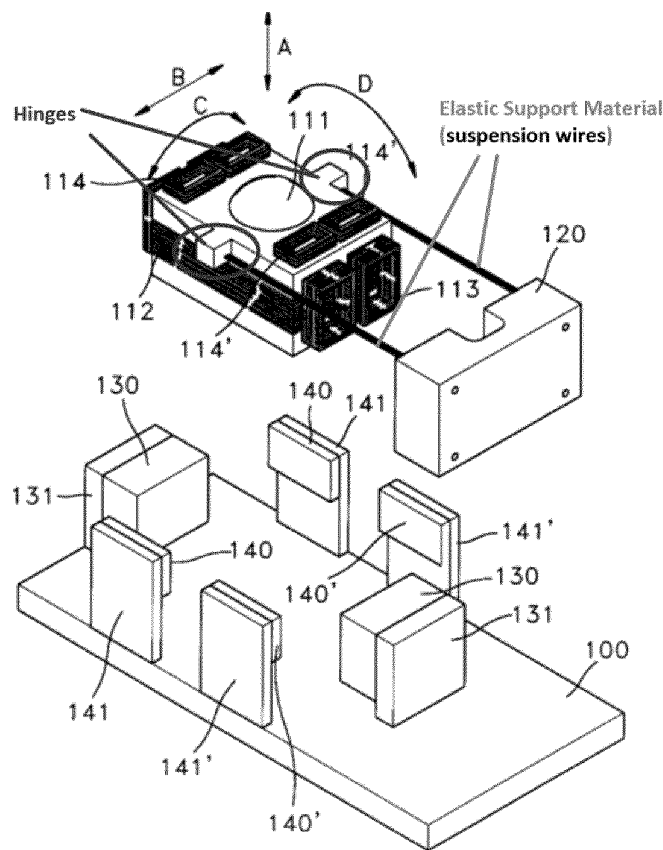
126. See element 1[a] in Ground 1.

c. 40[b]: “a plurality of suspension wires movingly supporting the blade on the base;”

127. See element 1[b] in Ground 1.

d. 40[c]: “a plurality of hinges each of [sic] coupled to an end of a suspension wire;”

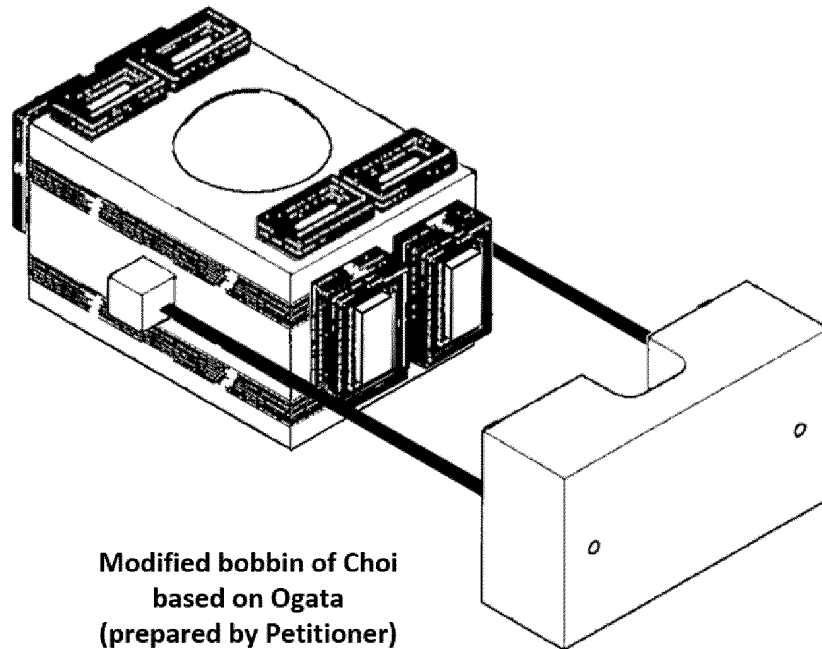
128. Choi describes a plurality of hinges for attachment of one end of the elastic support material (121) (suspension wires), as shown in annotated Figure 9 (below). Choi, 77, 132-133; Figure 4, Figure 9.



**Figure 9 of Choi
(annotated)**

129. In the Choi-Ogata combination, the hinges that are poisoned adjacent to the top surface of the bobbin would be moved to the empty space between the two

vertically separated focus coils, as shown in the modified example configuration below.



130. This modification would have been obvious and straightforward for a POSITA. For example, a POSITA would have observed that Ogata included connection points for attaching the elastic members located in the space between the separated subcoils, and thus would have understood that, when modifying Choi's bobbin, the pair of hinges could be moved to the empty space between the focus subcoils.

131. Additionally, by moving the hinges to the locations between the two focus coils, the bobbin would have had a better balance, flexibility and stability because the connection point would be closer to the center of mass of the bobbin.

e. 40[d]: “a pair of unipolar magnets positioned on the base; and”

132. See claim 7 in Ground 1. For element 40[d] in Ground 2, the magnets (130) of Choi are construed as the pair of unipolar magnets that are positioned on the base.

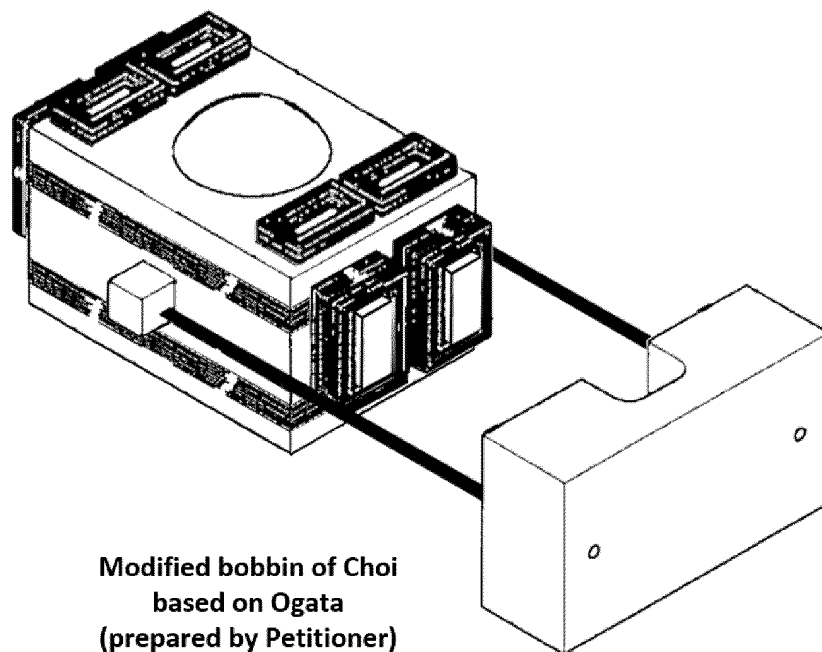
f. 40[e]: “a plurality of coils connected to an electric circuit and interacting with the unipolar magnets to create an electromagnet force to move the blade; and”

133. See element 1[d] in Ground 1. The Choi-Ogata combination includes several coils, including the vertically separated focus subcoils (Choi, 52, 133-134), four tracking coils (113), and four tilt subcoils (114, 114'). Choi, 132-135, 164-167, 182-186. The focusing subcoils and tracking subcoils interact with magnet (130), and tilt coils (114) interact with magnets (140, 140') to move the blade in the focus, tracking and tilt directions. Choi, 131-135, 162-163, 166-170. Any one or a combination of the above-mentioned set of subcoils can be construed as “a plurality of coils.”

134. It would have been obvious to a POSITA that the plurality of coils is connected to an electric circuit because Choi describes driving the coils with an electric current, and it was well known that electric currents are generated by electric circuits. Choi, 24-30, 182-182. See also, my explanation for element 40[e] in Ground 1.

- g. **40[f]: “wherein at least one of the plurality of coils is divided into subcoils and a hinge coupled to each of the plurality of suspension wires is between an adjacent pair of subcoils”**

135. This element is taught or suggested by the Choi-Ogata combination. As explained in connection with element 40[c], in this combination, the focus coil is divided into two vertically separated subcoils (adjacent pair of subcoils), and hinges are positioned in the space between those adjacent pair of subcoils for connecting the elastic wires. See figure below.



6. Claim 43: “The optical pickup actuator according to claim 40, wherein the coils are focus and tracking coils and the electric circuit supplies current to the coils in the same direction.”

136. As I explained in connection with Element 40[e], the Choi-Ogata combination includes several coils, specifically the vertically separated focus coils (Choi, 52, 133-134) and four tracking coils (113).

137. Regarding the phrase “wherein ... the electric circuit supplies current to the coils in the same direction” is ambiguous because it is unclear if the electric current in *all* focusing and tracking coils must be in the same direction, or in just a subset (i.e., at least two) of the coils. In all scenarios, the Choi-Ogata combination teaches or suggests these limitations.

138. First, the Choi-Ogata combination, Choi specifically describes that its coils (which include focusing and tracking coils) are driven by electric currents. Choi, 122-127, 157, 168-170, 182-185; see element 40[e]. It would have been obvious to a POSITA that the direction of the current could be selected for each coil (and subcoil) separately, and it would have been possible to drive all the coils with currents in the same direction (or in any direction). This may or may not have resulted in the desired movement of the optical pickup. But claim 43 does not require a specific movement of the optical pickup.

139. Second, if this claim is construed to require driving at least two coils with electric currents in the same direction, Choi describes it. This is consistent with the example provided in the '055 patent, in which if all focusing subcoils 150 are supplied with current in the same direction, the blade would move vertically up or down, depending on the direction of the current. Ex. 1001, 7:43-48.

140. Similarly, in the Choi-Ogata combination, Choi's focusing coil (112), (Choi, 133-135, 162-163), is broken up into two vertically separated subcoils, as I explained earlier. It would have been obvious to a POSITA that those focusing subcoils would be driven with currents in the same direction (either clockwise or counterclockwise) because the two focus subcoils would be generating a force in the same direction via their interactions with unipolar magnets (130), thus moving the coil in the focusing direction. See also discussion in Ground 1, claim 7. Otherwise, if one focus subcoil was driven with a current in the opposite direction compared to the other focus subcoil, the bobbin would likely not move, or move unpredictably.

7. Claim 44: “The optical pickup actuator according to claim 40, wherein the coils are focus and tracking coils, of which the focus coil also serves as a tilt coil and the electric circuit supplies current separately to each of the coils.”

141. I have been advised that the two phrases (1) “wherein ... the focus coil also serves as a tilt coil,” and (2) “[wherein] the electric circuit supplies current

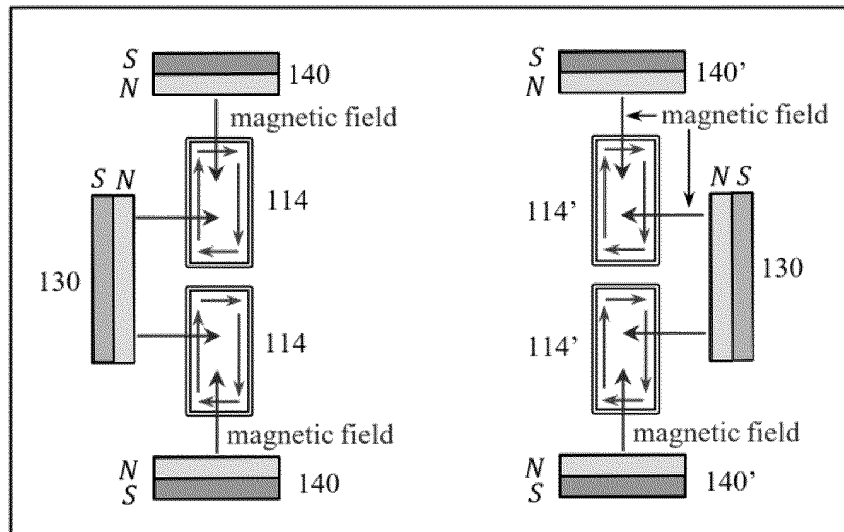
separately to each of the coils” recite functional limitations that should not be given patentable weight.

142. But even if those limitations are given patentable weight, the combination of Choi and Ogata teaches or suggests them. In the Choi-Ogata combination, Choi describes focusing coils (112), tracking coils (113) and tilt coils (114, 114’). Choi, 133-135, 162-163; see claim 40, *supra*. Choi’s tilt coils (114, 114’) (which could also operate as focusing coils) and tracking coils (113) render claim 44 obvious.

143. Specifically, it would have been obvious to a POSITA that Choi’s tilt coils (114, 114’) (which remain functionally the same in the combination with Ogata) can also be used for focusing purposes. Choi describes the interactions between tilt coils (114, 114’) and magnetic elements (140, 140’) can tilt the blade in tilt directions (C and/or D). Choi, 166-170. A POSITA would have found it obvious that by selecting the direction of electric currents in each of the tilt subcoils (114, 114’), the blade can also move up or down in the focusing direction due to the interaction of the tilt subcoils (114, 114’) with magnetic elements (140, 140’) and (130).

144. For example, the following illustration shows how by providing an electric current to the tilt subcoils (114, 114’) in the clockwise direction, the tilt subcoils can be used for moving the bobbin up and down in the focusing direction.

When using tilt coils (114, 114') to perform a focusing function, the coils 112 of the Choi-Ogata combination are not energized.



**Illustrative Figure – Tilt/Focus Operation
(Prepared by Petitioner)**

145. As shown by the above diagram, the currents in all four subcoils 114 and 114' are in the same direction (i.e., all four subcoils have clockwise as shown in the illustration, or all have counterclockwise currents). The magnetic field is produced by the magnets 140 and 140'. However, the magnets 130 also contribute in this case to the force acting on the tilt coils (now acting as focus coils) 114 and 114'. This is because the currents of the two subcoils facing each of the magnets 130 are now in the same direction and, therefore, the force of the magnets 130 on these subcoils can no longer be ignored.

146. The general physical principle used here to determine the direction of the force F exerted by a magnetic field B on an electric current J is known as the

Lorentz law of force ($\mathbf{F} = \mathbf{J} \times \mathbf{B}$). Think of \mathbf{F} , \mathbf{J} , and \mathbf{B} as three arrows forming a tripod—with the three arrowheads all pointing outward. The Lorentz law asserts the so-called “right-hand rule,” which is that the arrow of force \mathbf{F} will be oriented along your right-hand’s thumb when your remaining (right-hand) fingers close in the direction going from the arrow of the electric current \mathbf{J} toward the arrow of the magnetic field \mathbf{B} . In the preceding figure, every red arrow (corresponding to the magnetic field \mathbf{B}) that crosses a blue arrow (corresponding to the current \mathbf{J}), does so in such a way that the corresponding force \mathbf{F} points in the direction perpendicular to the page and pointing into the page. In this case, the bobbin as a whole will move into the page. If the directions of the electric currents (i.e., the blue arrows) in all four coils are reversed (i.e., all four current loops now going counterclockwise), then the force \mathbf{F} in every location where a red arrow crosses a blue arrow will flip over and point in the out-of-the-page direction. In this case, the bobbin as a whole will move out of the page.

147. Accordingly, by selecting to drive all subcoils (114, 114’) with electric currents in the same direction, those coils perform a focusing function. As explained in connection with claim 8 in Ground 1, subcoils (114, 114’) can serve as tilt coils and move the blade in different tilt directions by selecting a different set of directions of the electric current in those coils.

148. A POSITA with a basic familiarity with the operation of the optical pickup and disc drive assemblies, would have known and would have found it obvious to select the polarity of the magnetic poles and the direction of currents that energize the subcoils (114, 114') to cause the blade to move in tilt or in focus directions because these were among the very basic and fundamental features of an optical disc drive.

149. As I explained in connection with element 40[e], supplying electric currents to the coils was described in Choi (Choi, 122-127, 157, 168-170, 182-185), and supplying separate currents to each of the coils and subcoils would have been an obvious task to allow focusing, tilting and tracking functions, and to move the blade in multiple directions.

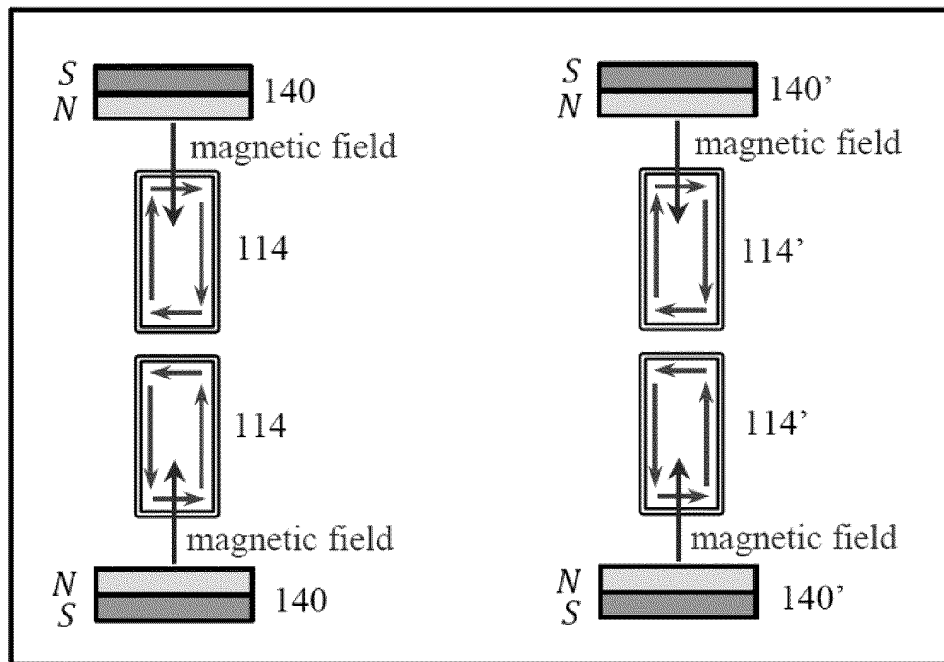
8. Claim 45: “The optical pickup actuator according to claim 40, wherein the coils are focus, tracking, and tilt coils and the circuit supplies current to the coils in opposite directions.”

150. The phrase “wherein ... the electric circuit supplies current separately to each of the coils” is ambiguous because it is not clear whether all or only a subset of the coils (tracking, tilts, focusing, or subcoils within each type of coil) are to be supplied with currents in opposite directions. This situation becomes even more perplexing when more than two coils (let’s say three coils) are involved, in which case, it is not clear how the currents in three coils can be in opposite

directions, given that a current is typically in either a clockwise or a counterclockwise direction.

151. Nonetheless, as I explained earlier, all focusing, tracking and tilt coils in the Choi-Ogata combination are capable of being driven with currents in any direction – the same direction or opposite directions. And the claim does not specify or require any particular movement of the optical pickup actuator. Notably, Choi describes focusing, tracking and tilt coils that are driven by an electric current. Choi, 122-127, 157, 168-170, 182-185; see also element 40[e].

152. Further, if this claim is construed to require the electric currents in two of the coils to be supplied in opposite directions, the Choi-Ogata combination renders this claim obvious. This would be consistent with some of the examples in the '055 patent where “the current is supplied to the [tilt] coils 131 and 132 in opposite directions.” Ex. 1001, 7:26-27. The same is true in the Choi-Ogata combination. For example, as I described in connection with claim 8 in Ground 1, a POSITA would have found it obvious that tilt subcoils (114) (and/or tilt subcoils 114') would be driven with currents in opposite directions to perform a movement in the tilting direction C. This scenario is illustrated in the below diagram (which was also provided for claim 8).



**Illustrative Figure – Tilt Coil Interaction
(Prepared by Petitioner)**

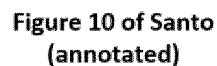
C. Ground 3: Choi in combination with Ogata and Santo Render Obvious Claims 41-42.

1. Brief Description of Santo (Ex. 1007)

153. Santo (U.S. Patent No. 6,344,936 B2) is titled “Objective Lens Driving Apparatus;” it was filed on September 28, 2000, and issued February 5, 2002. Santo’s disclosure relates to an objective lens driving apparatus used for recording/reproducing information on an optical disc. Santo, 1:3-7.

154. Santo describes using multiple support wires that attach to multiple connection points (hinges) on the blade in, for example, its Figure 10 embodiment: “the suspension wires 53a, 53b, 53c, and 53d are each fastened at one end to the

There are six suspension wires in total.” Santo, 16:25-28; Figure 10 (annotated below).



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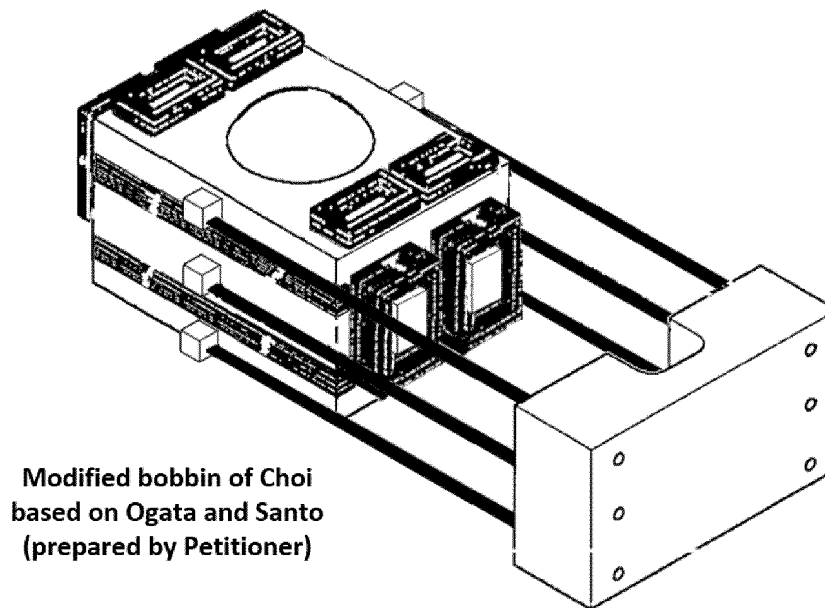
suspension wires are used to supply drive current to the tracking coils 56a and 56b.”

Santo, 17:4-9. The coils 55a-d and 56a, 56b are shown in Figs. 11A and 11B of Santo.

2. Claim 41: “The optical pickup actuator according to claim 40, wherein the plurality of suspension wires are at least six suspension wires and the coil is divided into three or more subcoils.”

156. As explained in Ground 2, the combination of Choi and Ogata renders base claim 40 obvious. In the Choi-Ogata combination in Ground 2, the blade includes a pair of connection points (hinges) that are positioned in the space between two vertically separated focus coils.

157. A POSITA would have found it obvious to add the additional hinges as explained by Santo. The below figure illustrates an example of the modified configuration that includes six connection points (hinges) on the blade and six associated wires that movably support the blade on the base. There are four hinges visible in this perspective view, but it should be clear that the remaining two hinges are positioned on the opposite side of the blade.



158. In the Choi-Ogata-Santo combination, the coil of the optical pickup assembly is divided into three or more subcoils, including the two focusing subcoils, four tilt subcoils (114, 114') and four tracking subcoils (113).

159. A POSITA would have found it obvious to include the additional hinges and suspension wires to the Choi-Ogata combination because the pickup assembly in the Choi-Ogata-Santo combination included three different types of coils (tracking, tilt and focus coils), and, as Santo explains, having six hinges and six suspension wires would have allowed each pair of suspension wires to deliver electrical current to a different type of coil. Santo, 17:4-9: *“Two suspension wires of the six suspension wires 53a to 53f are used to Supply drive current to the focusing coils 55a and 55c. Two suspension wires are used to supply drive current*

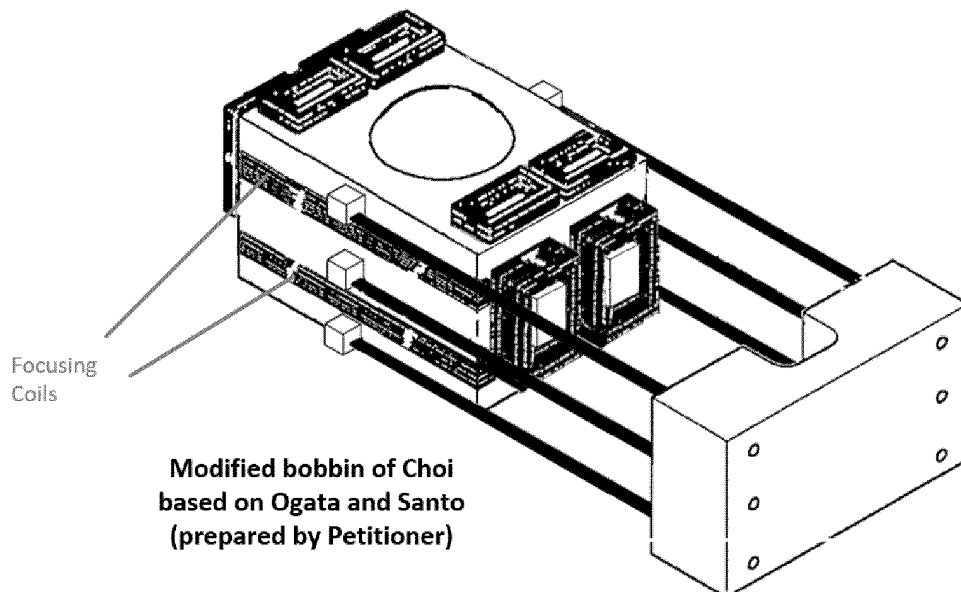
to the focusing coils 55b and 55d. The remaining two Suspension wires are used to Supply drive current to the tracking coils 56a and 56b.”

160. Furthermore, including additional hinges and connection points would have provided a more secure and stable platform, and would have distributed the weight of the blade and associated components (objective lens, coils, and the like) among additional support points, which would have improved the performance and longevity of the optical pickup assembly.

161. Also, those modifications involved routine mechanical and electrical modifications that were well within the capabilities of a POSITA, and the POSITA would have undertaken those modifications with a high expectation of success.

3. Claim 42: “The optical pickup actuator according to claim 40, wherein a first hinge and a second hinge are positioned on each of a top and a bottom of one of the coils, respectively, and a third hinge is positioned between two of the subcoils.”

162. This claim is rendered obvious by the Choi-Ogata-Santo combination as shown in claim 41, and illustrated in the annotated figure below, where the coils are the vertically separated focus coils. As evident from this configuration, the top (and bottom) pair of hinges are on top (and bottom) of the coils (i.e., on top and bottom of focusing coils), and the middle pair of hinges is between the two focus coils.



D. Ground 4: Choi and Ikeda Render Obvious Claims 7 and 8.

1. Brief Description of Ikeda (Ex. 1005)

163. Ikeda is U.S. Patent Publication No. 2003/0007430 A1, titled “Objective Lens Driver and Disk Drive Device Comprising the Same,” and was published on January 9, 2003. Ikeda describes an objective lens driver that includes, *inter alia*, a base, a support shaft, a pair of yokes, an objective lens, a focusing coil (24) and at least a pair of tracking coils (25). Ikeda, Abstract.

DECLARATION OF MASUD MANSURIPUR, PH.D.
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 7,266,055

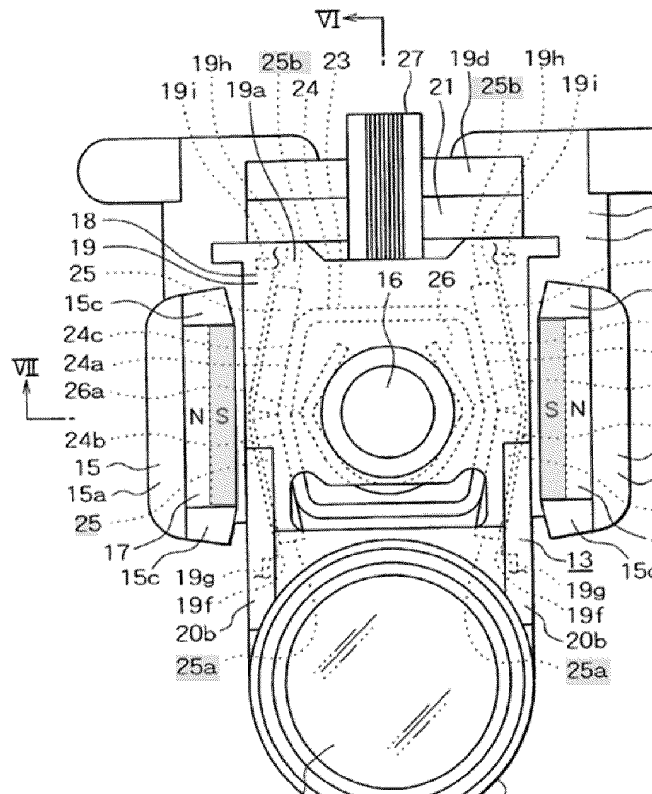


Figure 5 of Ikeda (annotated)

164. Choi describes interactions between the magnets 130 or 140/140' with the corresponding coils. For example, Choi describes: "... the first magnet 130 and the first yoke 131 are provided on the base 100 to interact with the current flowing through the coils 112 and 113." Choi, 134-135. Choi further describes: "the interaction between the current flowing in the tilt coils 114 and 114' and the magnetic force generated by the second magnets 140 and 140' and the second yoke 141 and 141 causes the tilt operation to be implemented in the directions of arrows C and D." Choi, 168-170.

165. As I explained in connection with claims 7 and 8 in Ground 1, while a POSITA would have found it obvious that Choi's magnets were "unipolar" magnets and interacted with the corresponding coils in unipolar manner, Choi did not explicitly describe it. Ikea, however, confirms the unipolar interaction.

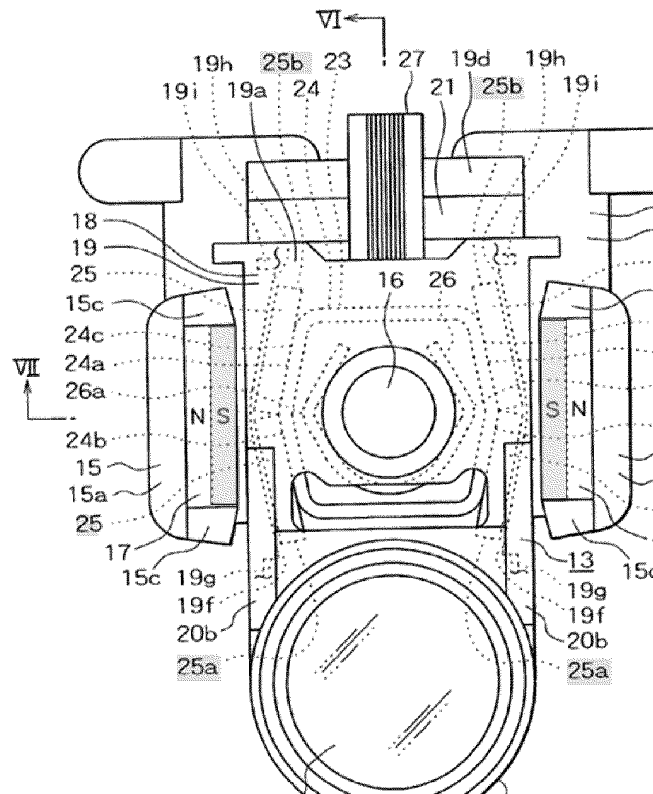


Figure 5 of Ikeda (annotated)

166. In particular, Ikeda describes that "pairs of tracking coils 25 are fitted respectively to both side portions 24a of a focusing coil 24 wound in a roughly prismatic form" (Ikeda, ¶54), and both the focusing coil (24) and tracking coils (25) interact with the same polarity (south pole) of magnetic elements 17 that are placed on opposite sides of the blade (see annotated Figure 5 above). Ikeda, ¶45: "Magnets

17 are fixed on the inside surfaces of the yokes 15, respectively. The *magnets 17 have the same pole on their surfaces facing to each other*, and their surfaces on the side of the support shaft 16 are S poles (See FIG. 5).” See also, *id.*, ¶¶66, 73-74, 77.

167. Therefore, Ikeda reinforces a POSITA’s understanding of Choi’s operation based on unipolar interaction and a POSITA would have found it obvious that interaction of coils in Choi would be with magnets 130 (in claim 7) and with magnetic elements 140/140’ (in claim 8) that have the same polarity.

E. Ground 5: Choi in combination with Ogata and Ikeda Renders Obvious Claims 40 and 43-45

168. As explained in Ground 4, Ikeda corroborates the teachings of Choi and provides further confirmation that a POSITA would have found it obvious that Choi’s coils interact with the magnets 130, 140, 140’ in a unipolar fashion. Ikeda reinforces a POSITA’s understanding that the magnetic fields of Choi’s unipolar magnets (130, 140/140’) interact with the electric currents flowing through the tracking, focusing and/or tilt coils to produce electromagnetic forces.. In the Choi-Ogata-Ikeda combination, the analyses of claims 40 and 43-45 of Ground 2 are augmented by the knowledge of a POSITA, as confirmed by Ikeda, and render claims 40 and 43-45 obvious.

F. Ground 6: Choi in combination with Ogata, Santo and Ikeda Renders Obvious Claims 41 and 42

169. As explained in Ground 4, Ikeda corroborates the teachings of Choi and provides further confirmation that a POSITA would have found it obvious that Choi's coils interact with the magnets 130, 140, 140' in a unipolar fashion. In the Choi-Ogata-Santo-Ikeda combination the analyses in connection with claims 41-42 of Ground 3 are augmented by the knowledge of a POSITA, as confirmed by Ikeda, that the magnetic fields of Choi's unipolar magnets (130) interact with the electric currents flowing through the tracking and/or focusing coils to generate the requisite electromagnetic force.

G. Ground 7: Ogata and Kamata Render Obvious Claims 36-38.

1. Brief Description of Kamata (Ex. 1004)

170. Kamata is a Japanese patent application publication titled "Optical pickup actuator device," which was published on July 30, 1999. Kamata relates to "an actuator device for an optical pickup that records or reproduces information on a medium such as a compact disc or mini disc." Kamata, 45-56. The optical pickup actuator device of Kamata includes "a lens holder that holds an objective lens, a focus coil wound in a direction perpendicular to the optical axis of the objective lens, a pair of tracking coils that are arranged in parallel in a direction perpendicular to the focus coil and whose winding directions are opposite to each other." Kamata, 34-36.

171. Kamata further describes that its optical pickup actuator includes “a magnet and a yoke having opposing surfaces facing each other with the focus coil and tracking coil therebetween.” Kamata, 36-37. Kamata’s yoke is further described in connection with Figure 2 (annotated below). The yoke includes “the auxiliary yokes 12 are integrally formed on both sides of the U-shaped yoke 3 whose upper end is open, and which are bent approximately at right angles to one inner wall surface 3a;” Kamata, 119-120.

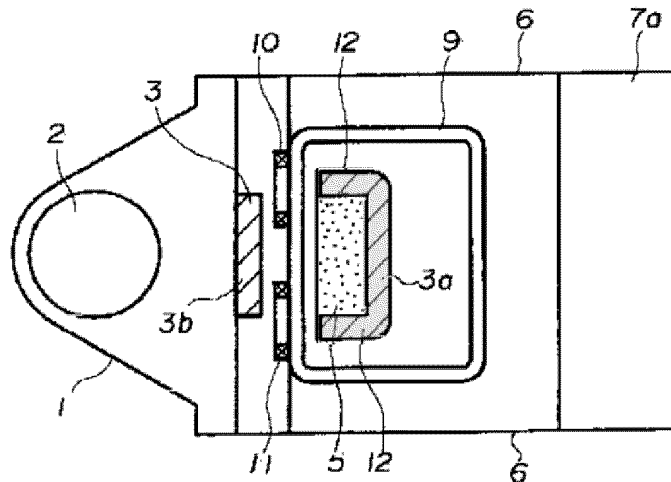


Figure 2 of Kamata (annotated)

172. Kamata explains that its invention seeks to solve a problem associated with the conventional systems that use a yoke without those bent sections (such as the one shown in Kamata’s Figure 7). Namely, in those systems “... there is also magnetic flux directed obliquely to the tracking coils 10 and 11 from both sides of the permanent magnet 5, so that the magnetic flux density distribution on both sides

of the tracking coils 10 and 11 is in an unbalanced state.” Kamata, 68-71. Kamata’s solution entails using a yoke with two bent sections (as shown in Figure 2) that “reduce the magnetic flux directed obliquely from the permanent magnet 5 to both the tracking coils 10 and 11.” Kamata, 121-124.

173. As a result, a more uniform magnetic field density around the tracking coils is generated, and the undesirable rotational movements of the lens holder are eliminated. Kamata, 153-155; see also, *id.*, 89-90: “Providing such an auxiliary yoke eliminates the imbalance of magnetic flux densities on both sides of the tracking coil, thereby preventing undesired rotational motion from being induced in the movable part.”

2. Motivation to Combine Ogata and Kamata with a Reasonable Expectation of Success

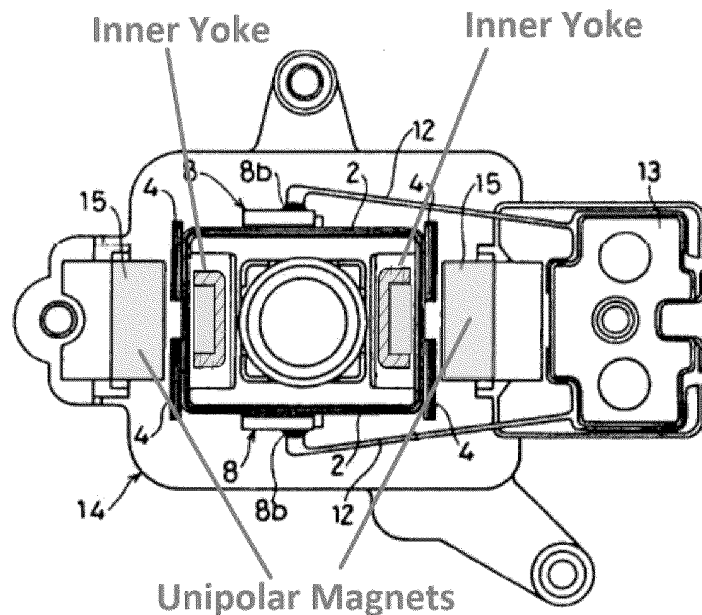
174. A POSITA would have found it obvious to combine the teachings of Kamata with Ogata.

175. Both Ogata and Kamata related to optical pickup devices for reading or recording information on optical discs (Ogata, 29-31, 81-87; Kamata, 45-46) and both references improved the operations of optical disc drives compared to prior systems. Ogata, 104-108, 187; Kamata, 83-90. And a POSITA would know that the complementary teachings of those references could be combined to improve the operations of the optical disc drive.

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178. The modification – already described in Kamata (lines 116-188, for example) – required routine mechanical modifications to Ogata’s device, which a POSITA could have undertaken with a reasonable expectation of success.

179. An example modification is shown in the diagram below.



Modified Figure 4 of Ogata

3. Claim 36

- a. 36[pre]: “An optical pickup actuator for use with an objective lens on a base, comprising:”

180. Ogata describes the preamble limitations by disclosing “[a] lens drive support, equipped with an objective lens holder having an objective lens that focuses a light beam on an optical recording medium.” Ogata, 18-19. Ogata further describes a base in the form of substrate 14. Ogata, 112: “the lens drive support is

equipped with a substantially rectangular substrate 14; see also, Figures 3 and 4.
Other components such as a drum and magnets were fixed to the substrate. Ogata,
114-116, 156.

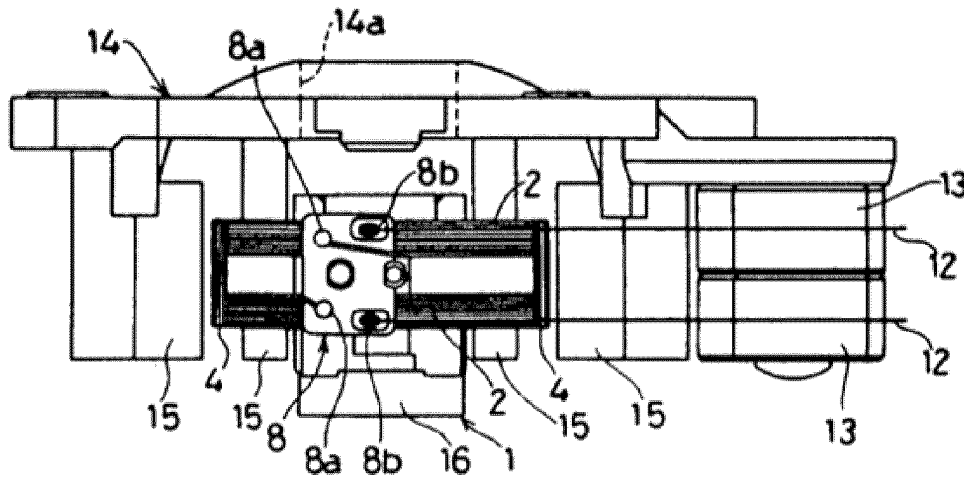


Figure 3 of Ogata

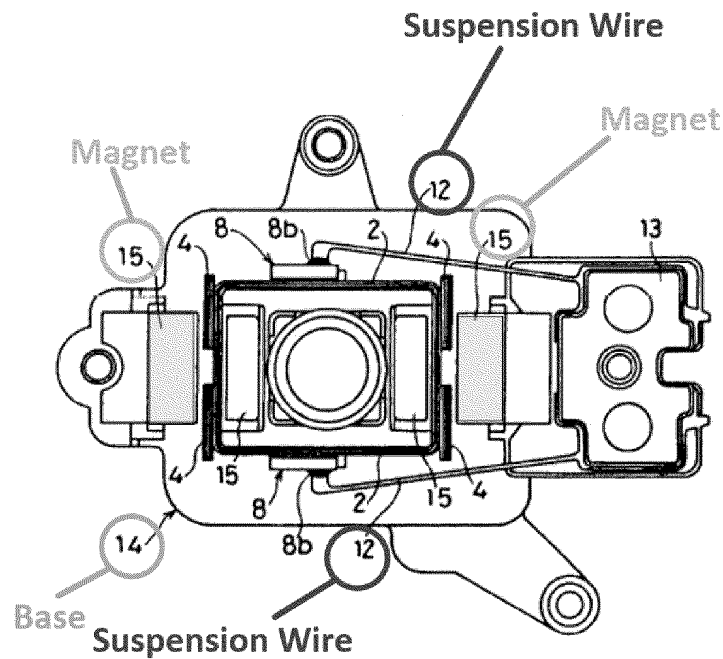


Figure 4 of Ogata (annotated)

b. 36[a]: “a blade holding the objective lens:”

181. Ogata describes a blade for holding an objective lens, as illustrated in the annotated Figure 1 of Ogata (below). Ogata, 112-114. The blade accommodated focus coils 2, and radial drive (tracking) coils (4), and included an opening (1) for holding an objective lens, as illustrated in annotated Figure 1 below. Ogata, 81-84, 119-125, 151-152.

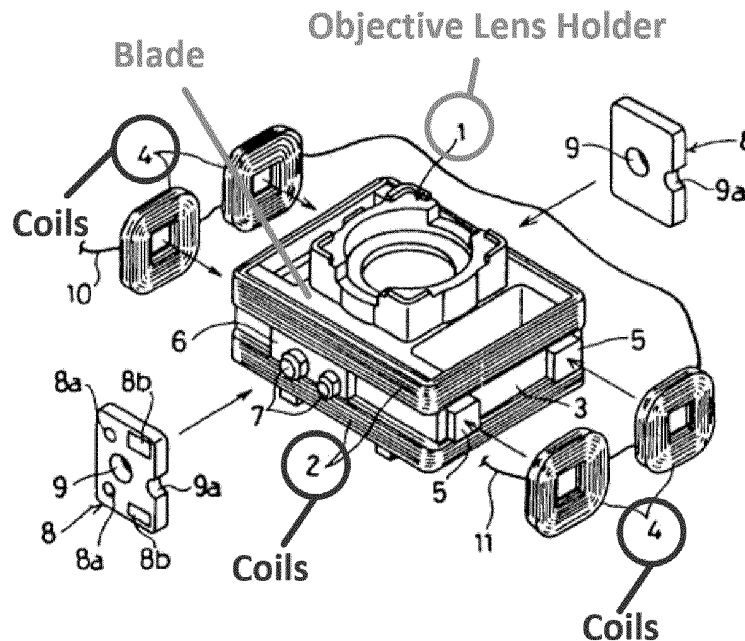


Figure 1 of Ogata (annotated)

c. 36[b]: “a plurality of suspension wires movingly supporting the blade on the base:”

182. Ogata describes a plurality of suspension wires in the form of four leaf springs (12). Ogata, 156-157. The leaf springs (suspension wires) support the blade on the base because they are connected to the blade at one end, and, on the other end,

to the drum support member (13) that is positioned on the substrate (14) (“base”).

Id. In this way, the blade is “**movable** in the focus direction and the radial direction.”

Ogata, 157-158; see also annotated Figure 4 of Ogata (below).

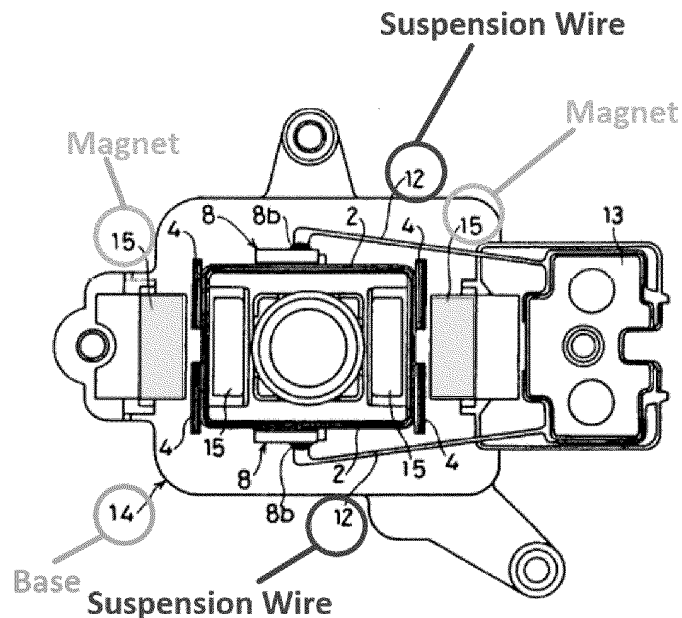


Figure 4 of Ogata (annotated)

d. 36[c]: “a pair of unipolar magnets positioned on the base; and:”

183. Ogata describes a pair of magnets (15) that are positioned on the substrate (14) (base), as annotated in green in Figure 4 above. I should note that Ogata’s Figures 3 and 4 mistakenly label the magnets that are positioned within the blade (i.e., the two magnets that are adjacent the lens 16 in Figure 3; the magnets 15 are colored green in the annotated Figure 4 above) with reference number 15. The specification of Ogata makes it clear that those magnets should be labeled with reference number 17. Ogata, 115-121, 163.

184. With respect to this claim element, Ogata describes “a pair of substantially rectangular parallelepiped-shaped magnets 15 are erected on the substrate 14 so as to face each other in the longitudinal direction of the substrate 14 with the opening 14a therebetween.” Ogata, 114-116. These magnets are highlighted in green in the above annotated Figure 4 of Ogata.

185. Ogata does not explicitly state that the pair of magnets are unipolar, but this would have been obvious to a POSITA. Notably, because the green annotated magnets (15) interacted with the focus coils (2) that wrapped around the periphery of the blade, the same pole of those magnets would be facing the focus coils to allow proper up or down movement of the blade. Please refer to my explanations in connection with claim 7 in Ground 1 for a more detailed explanation of unipolar interactions that applies to 36[c], as well.

186. Additionally, this unipolar interaction of the tracking coils (4) with magnets (15) are further described and corroborated by Ikeda, as I explained in Ground 4.

e. 36[d]: “a plurality of coils positioned on the blade and interacting with the unipolar magnets to create an electromagnet force to move the blade; and:”

187. Ogata describes a plurality of coils in the form of focus coils (2) and radial direction drive coils (4) (i.e., tracking coils) that are positioned on the blade. Ogata, 126-130; Figure 1 (annotated below). According to Ogata, the coils interact

with the magnetic elements (magnets 15 – annotated in green in Figure 4 below) to move the blade in the focusing direction and in the radial (tracking) direction. Ogata, 161-163.

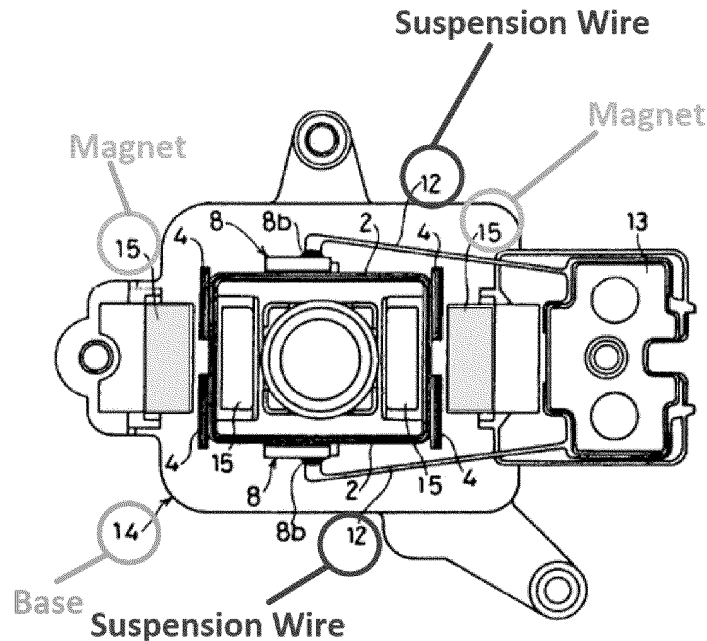


Figure 4 of Ogata (annotated)

- f. 36[e]: “an inner yoke positioned inside a cavity defined by the walls of a coil, wherein the yoke comprises three sections with each of the three sections of the yoke being parallel to a different wall of the cavity to increase an effective area facing the magnets.”

188. The combination of Ogata and Kamata teaches or suggests this limitation. As explained above, in the combination, the inner yoke of Kamata having two bent end sections is added to the magnets that are located inside the blade of Ogata. The inner yokes in this combination are attached to the substrate (14) (base)

and are positioned in a cavity augmenting Ogata's original magnets such that the sections of the yoke surround three sides of the magnet – similar to Kamata's configuration.

189. The combination, teaches or suggests the claimed cavity in the form of the hollow region surrounded by and defined by the focus coil 2 of Ogata, as illustrated in the annotated figure below. The right-hand side of the figure shows the focus coils by themselves and illustrates that the four walls of those coils define a cavity within the coils. The cavity is the hollow volume inside the rectangular-shaped focus coils.

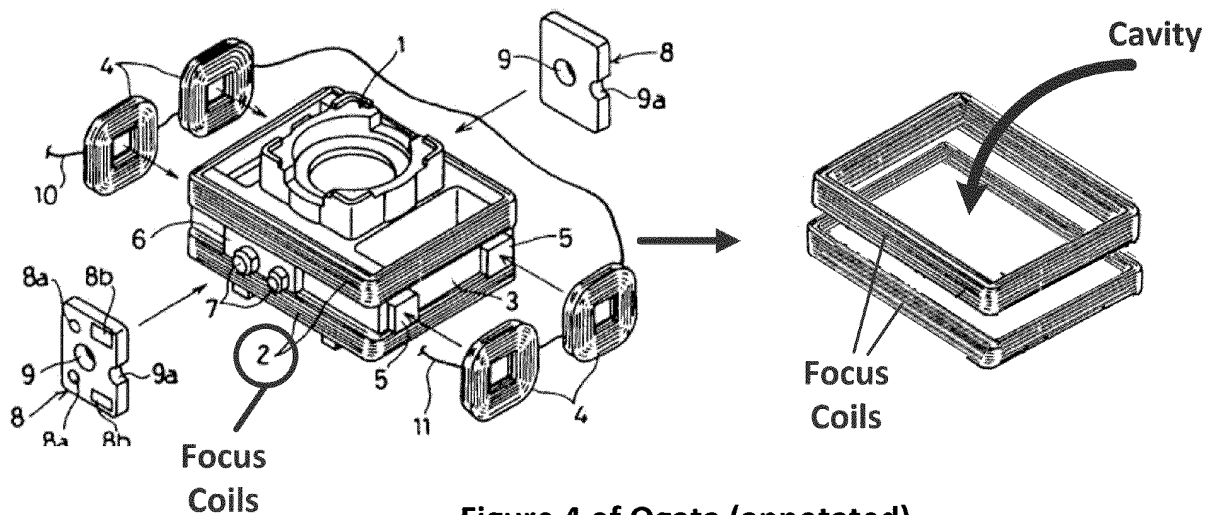
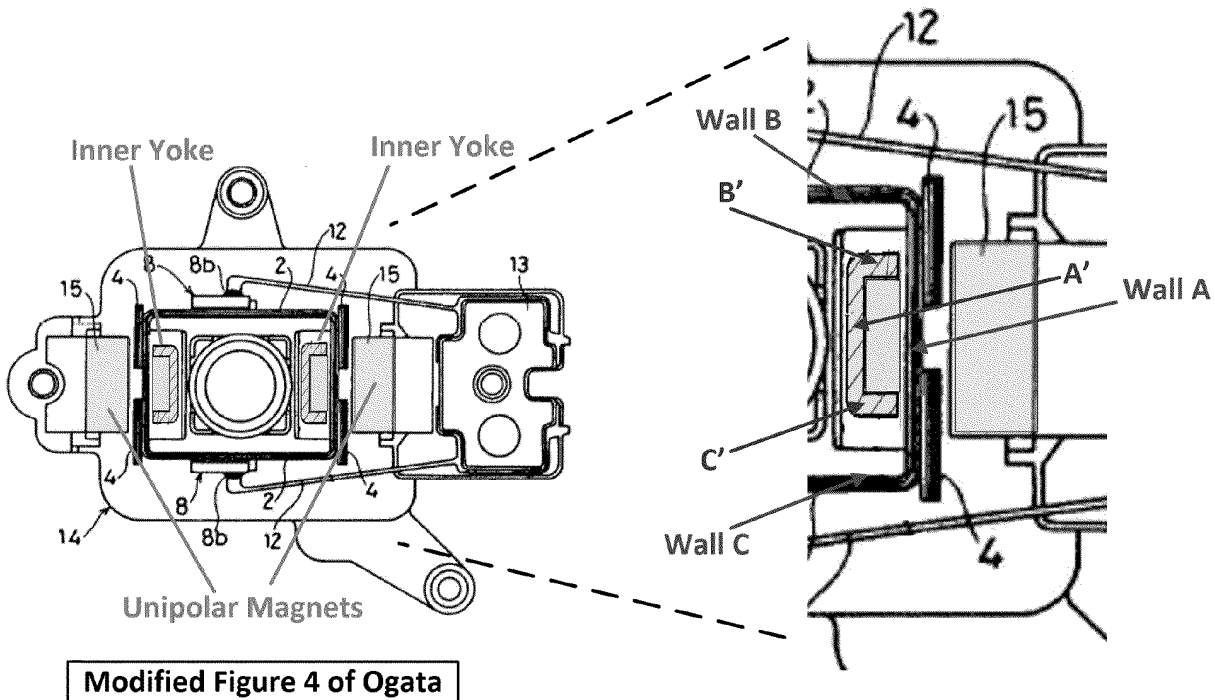


Figure 4 of Ogata (annotated)

190. In the combination, the inner yoke (annotated in cross-hatched green in modified Figure 4 below) has three sections: a first bent section (labeled as B'), a second bent section (labeled C'), and a straight section (labeled A') connecting the

two bent sections; each of the sections of the inner yoke, A', B' and C', is parallel to walls A, B, and C of the cavity, respectively. That is, as shown in the top-view illustration of Figure 4 below, the top bent section (B') of the yoke is parallel to cavity Wall B, the bottom bent section of the yoke (C') is parallel to cavity wall C, and the straight section of the yoke (A') is parallel to cavity wall A.



191. In an alternate mapping of the “cavity” that is shown in the annotated figure below, the cavity includes one or both of hollow regions that already exist inside Ogata’s blade. Each cavity, or the cavity pair, is defined by the walls of the focus coils (2). For example, the cavity is enclosed and defined by the wall of upper focus subcoil and the wall of the lower focus subcoil.

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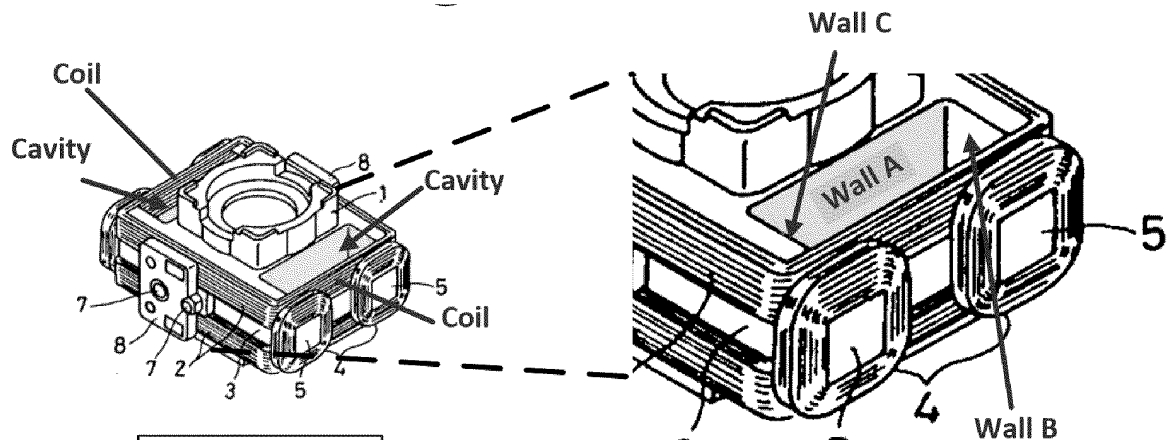
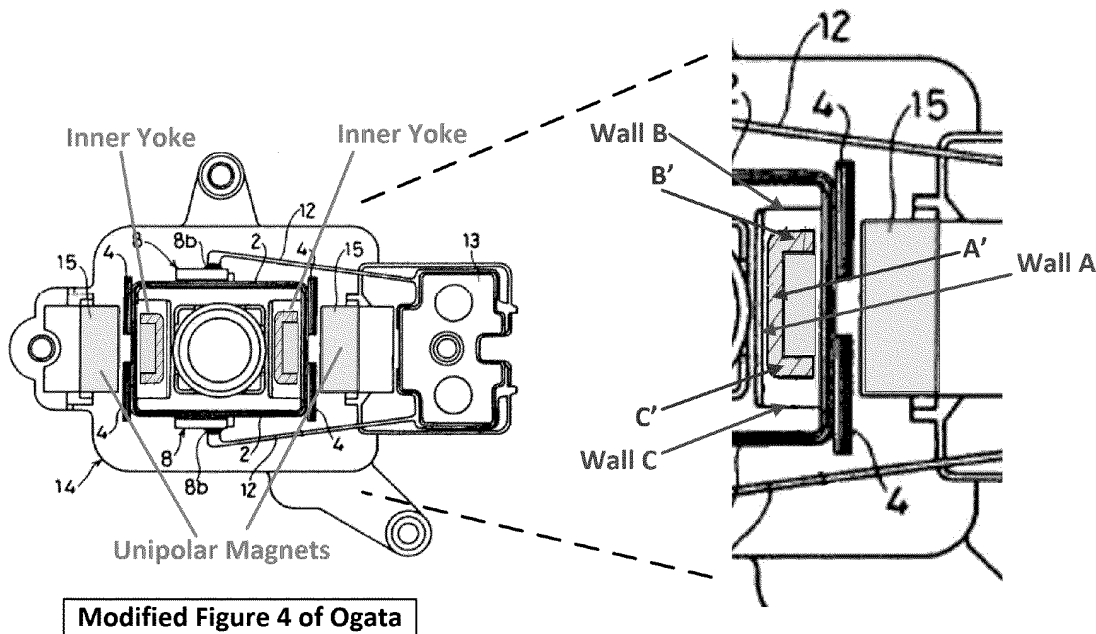


Figure 2

(Annotated Figures of JHP04113524A)

192. In the combination, the inner yoke (annotated in cross-hatched green in modified Figure 4 below) has three sections: a first bent section (labeled as B'), a second bent section (labeled C'), and a straight section (labeled A') connecting the two bent sections; each of the sections of the inner yoke, A', B' and C', is parallel to walls A, B, and C of the cavity, respectively. Notably, in the top-view illustration of Figure 4 below, the top bent section (B') of the yoke is parallel to cavity Wall B, the bottom bent section of the yoke (C') is parallel to cavity wall C, and the straight section of the yoke (A') is parallel to cavity wall A.



193. In both mappings of the “cavity,” the two bent sections of the yoke operate to “increase an effective area facing the magnets” compared to a yoke without the bent sections (and compared to Ogata having no inner yoke) because the yoke in the Ogata-Kamata combination has two bent sections and therefore has a larger effective area facing the magnet 15. In particular, the net result of bending the yokes is to confine and strengthen the magnetic field acting on the tracking coils; this is an increase in the effective area of the yoke facing the magnets. As explained in Kamata, the bent sections of the inner yoke reduce the magnetic flux directed obliquely from the magnet 15 to both tracking coils and provide a more streamlined and directed magnetic field to the tracking coils. Kamata, 128-129.

4. **Claim 37: “The optical pickup actuator according to claim 36, wherein one of the coils is divided into a plurality of subcoils that are separated from one another.”**

194. In the Ogata-Kamata combination, the configuration of the focus coils (2) of Ogata is unchanged. Therefore, the two focus coils (2) are separated from one another, as evident from the annotated Figure 1 of Ogata (below).

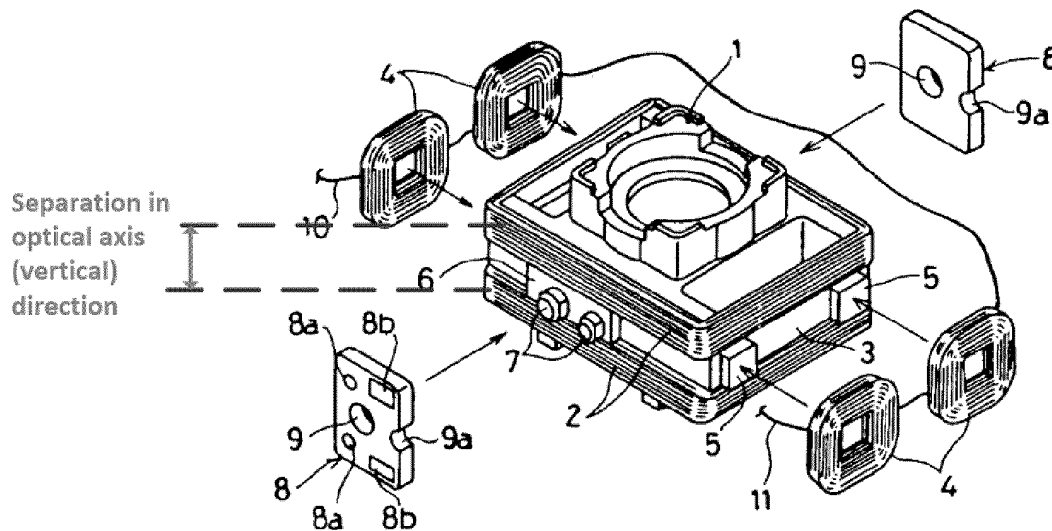


Figure 1 of Ogata (annotated)

5. **Claim 38: “The optical pickup actuator according to claim 36, wherein one of the coils is positioned to surround the sides of the blade.”**

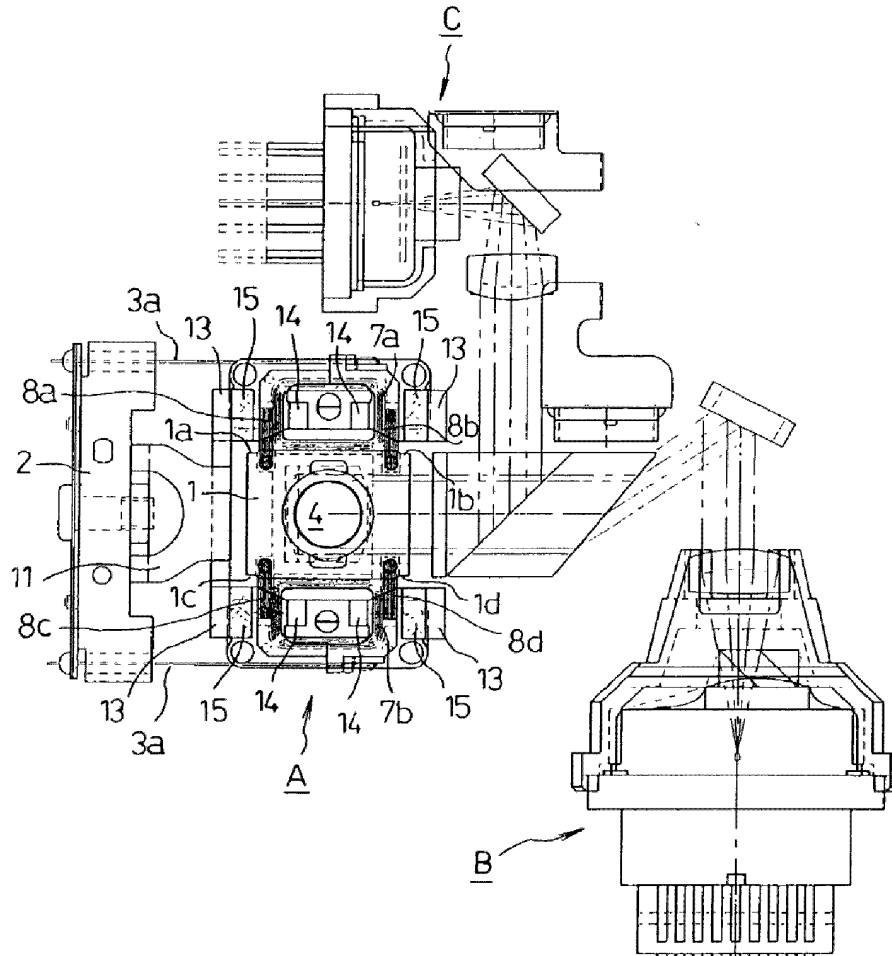
195. In the Ogata-Kamata combination, the configuration of focus coils (2) of Ogata is unchanged, and those coils are positioned to surround the blade, as evident from the annotated Figure 1 of Ogata (above).

**H. Ground 8: Kabasawa alone or in view of AAPA Renders Obvious
Claims 17, 21 and 23-24, 28**

1. Brief Description of Kabasawa (Ex. 1008)

196. Kabasawa (Ex. 1008) is U.S. Patent Publication No. 2003/0067848 A1, titled “Optical Pickup Apparatus,” and was published on April 10, 2003. Kabasawa describes an optical pickup apparatus with improved resonance characteristics that is appropriate for a notebook PC. Kabasawa, Abstract. Kabasawa’s optical pickup apparatus includes, among others, an objective lens 4, focus coils (7a, b), tracking coils (8a-8d), yokes (13,14), and permanent magnets (15) that interact with the coils. Kabasawa, Abstract, Table on p. 3, ¶¶43-44, 49, Fig. 1.

Fig. 1



2. Claim 17

- a. 17

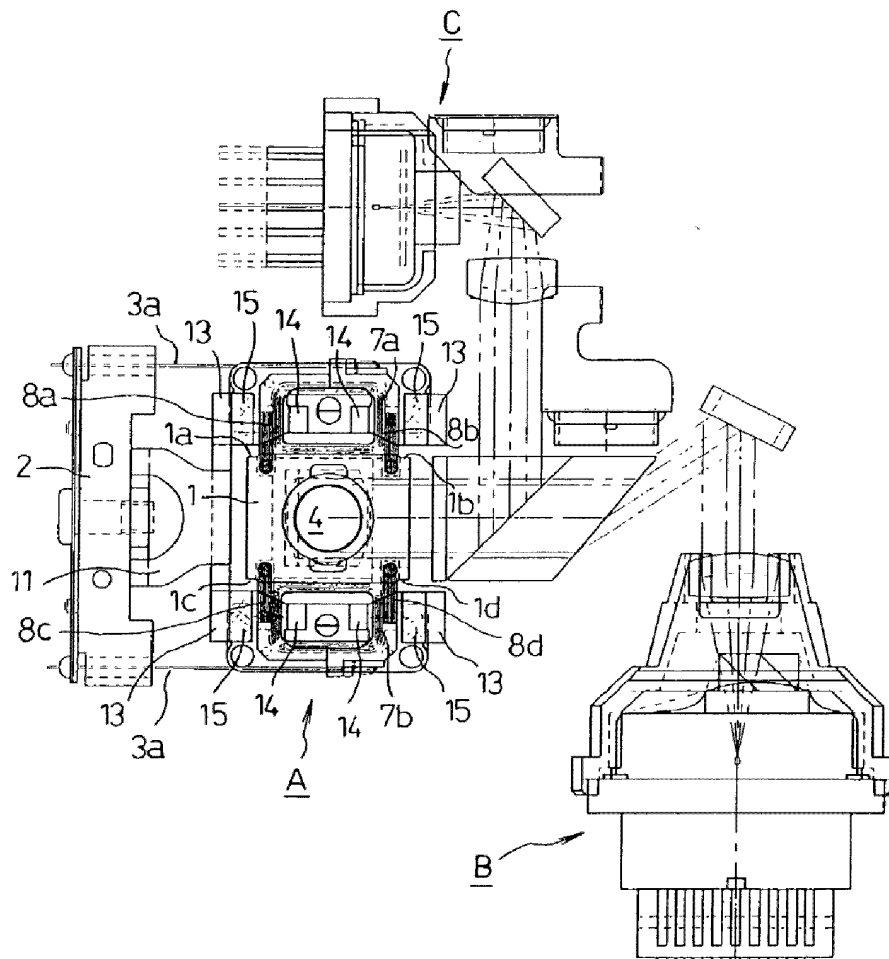
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[pre]: “An optical pickup actuator for use with an objective lens on a base, comprising:”
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197. Kabasawa describes an optical pickup actuator as part of its optical pickup apparatus that includes a base 11 that accommodates a lens holder 1 that includes an objective lens 4, and various focus (7a, 7b) and tracking (8a-8d) coils that can move the lens holder in focus and tracking directions. Kabasawa, Abstract,

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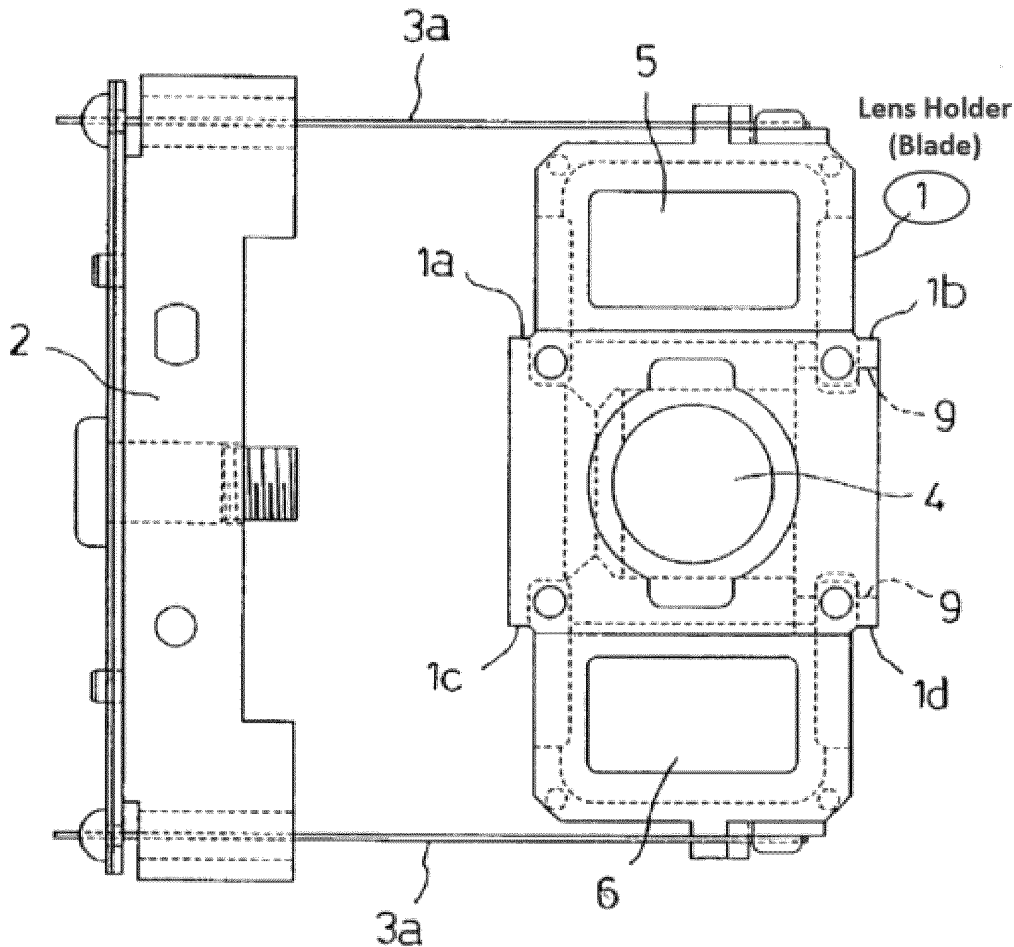
Table on p. 3, ¶¶33, 44, 48, Figs. 1-3. This is similar to the description of the optical pickup actuator provided in the '055 patent, which I provided in paragraph 48 of this declaration.

Fig. 1



b. 17[a]: “a blade holding the objective lens;”

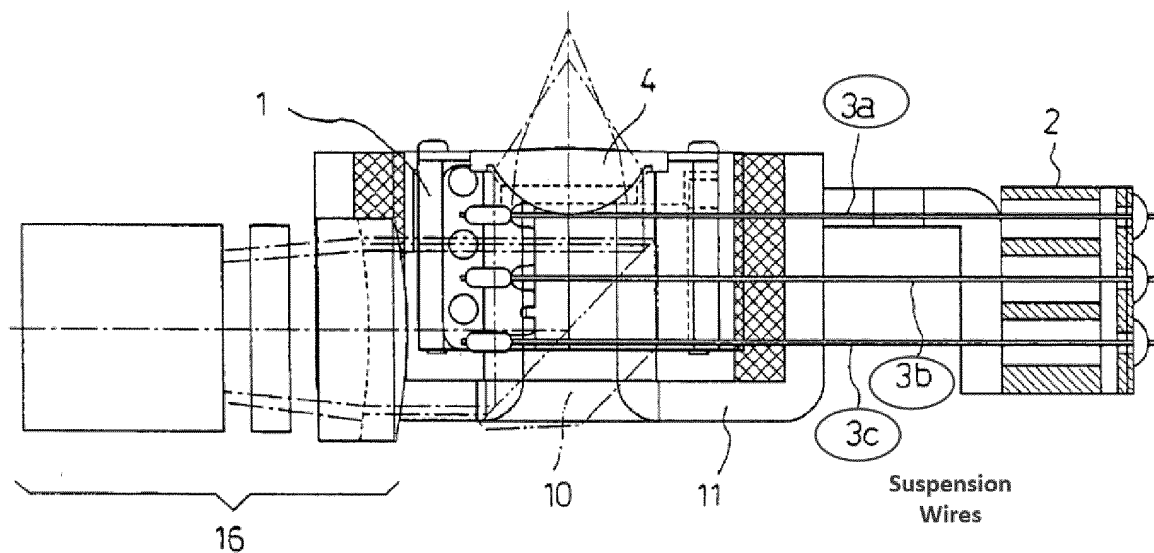
198. Kabasawa describes a blade in the form of a lens holder 1 component (see Figure 2 below) that “holds an objective lens 4 in the middle.” Kabasawa, Table on p. 3, ¶¶34, 44, Figs. 1 and 2.



**Figure 2 of Kabasawa
(Annotated)**

c. 17[b]: “a plurality of suspension wires supporting the blade on the base so that the blade is elastically movable;”

199. Kabasawa describes a plurality of suspension wires, namely, “three suspension wires 3a, 3b, 3c per one side,” that attach the lens holder 1 to a suspension holder 2. Kabasawa, Table on p. 3, ¶44, Figs. 2 and 3.

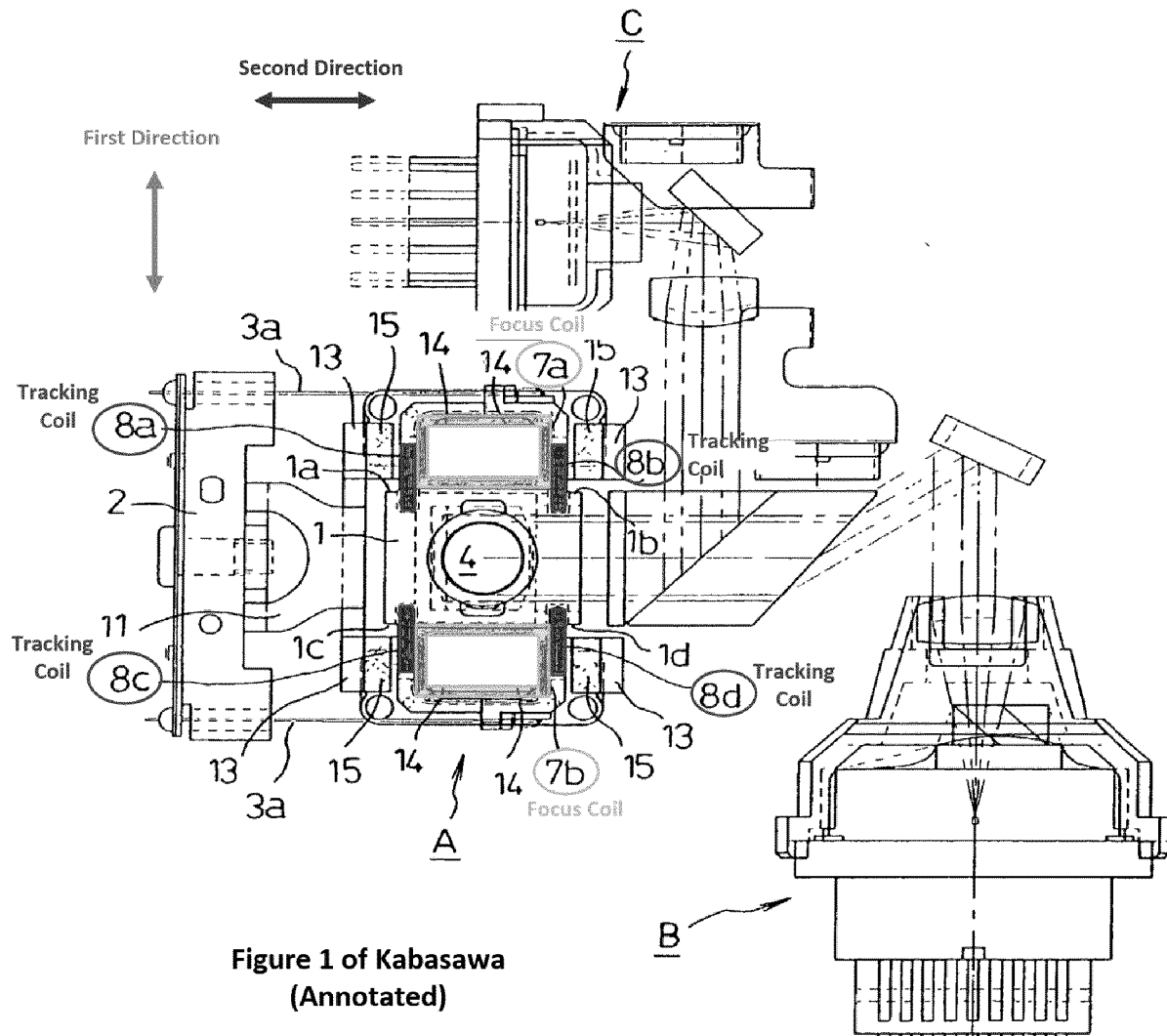


**Figure 3 of Kabasawa
(Annotated)**

200. Furthermore, Kabasawa is explicit that all suspension wires are elastic, and the middle suspension wire is made more flexible than the top and bottom ones. Kabasawa, ¶¶46, 47.

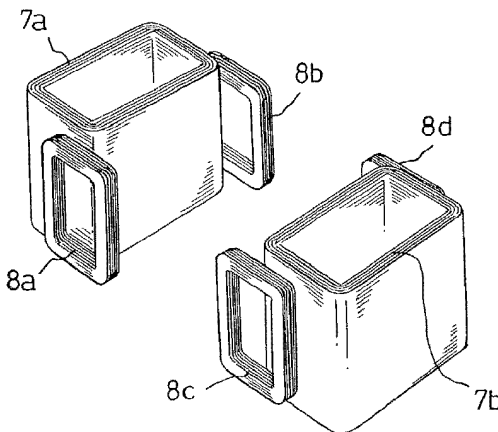
- d. 17[c]: a pair of first coils positioned horizontally on the blade and disposed opposite each other with respect to the objective lens in a first direction;

201. Kabasawa describes a pair of first coils in the form of focus coils 7a and 7b as shown in annotated Figure 1 below. See Kabasawa, Abstract, Table on p. 3, ¶44. The focus coils 7a, 7b are positioned horizontally on the blade and are opposite each other with respect to the objective lens (i.e., element labeled 4). *Id.*



202. The focus coils (7a, 7b), which are on the lens holder 1, are positioned in the first direction as shown in annotated Figure 1 above, and are wound in the horizontal direction, as further illustrated in Figure 6 of Kabasawa; see also Ground 1, Element 1[d], for explanation of “horizontal” configuration of the coils.

Fig. 6



- e. **17[d]: “a second coil positioned vertically on a side of the blade in a second direction perpendicular to the first direction; and”**

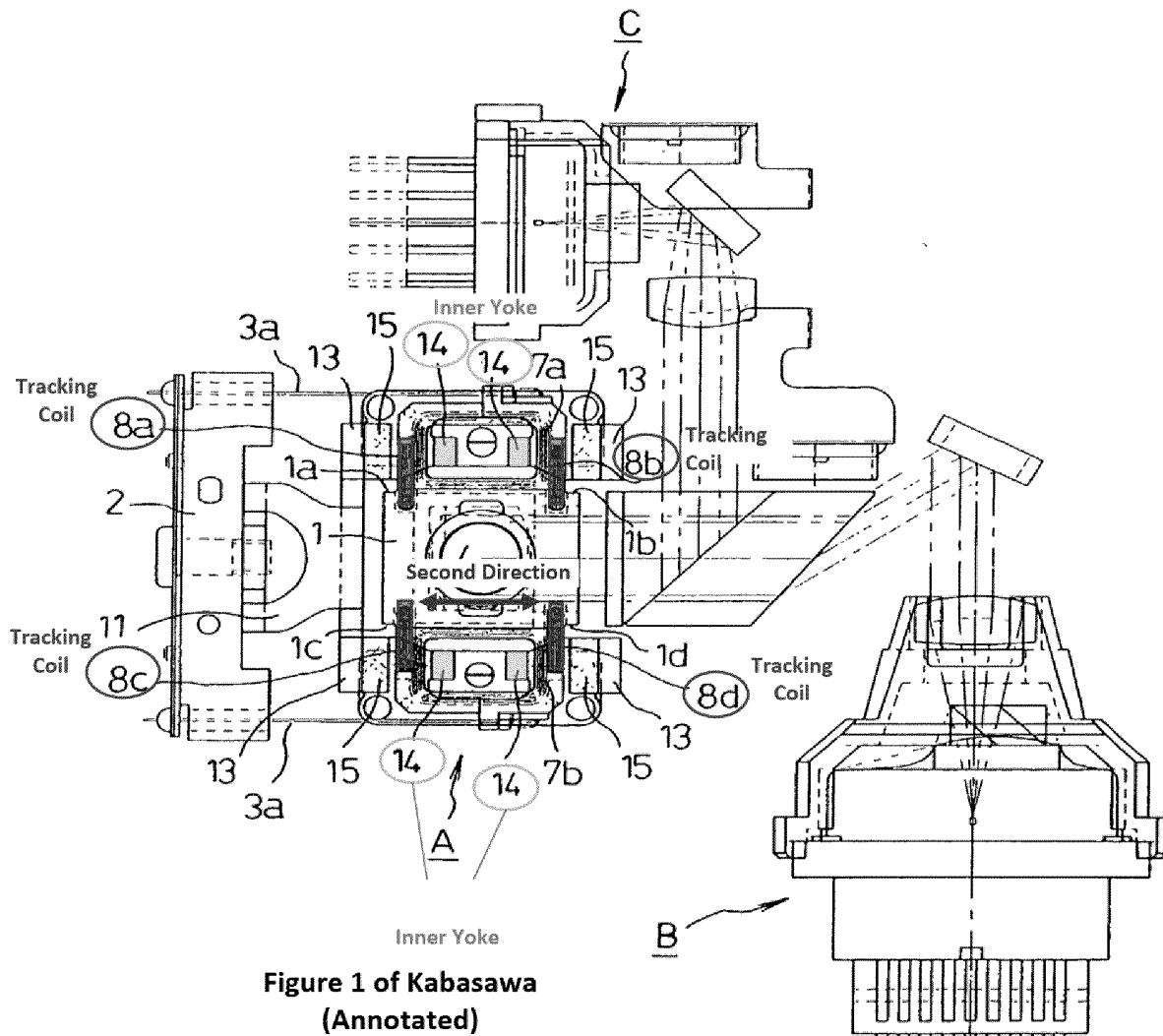
203. Kabasawa describes a second coil in the form of tracking coils 8a to 8d. In particular, tracking coil pairs 8a and 8b, as shown in annotated Figures 1 and 6 (above), are positioned on a side of lens holder 1 in a second direction that is perpendicular to the first direction. Kabasawa, Abstract, Table on p. 3, ¶44. For example, the winding direction of tracking coil 8a and 8b as shown in Figure 6 above is perpendicular to the winding direction of the focus coil 7a, and they are

positioned in along the second direction (perpendicular to the first direction), as shown in annotated Figure 1 above.

- f. **17[e]: “an inner yoke positioned on the base, the inner yoke positioned inside a cavity defined by each of the first coils, wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.”**

204. Kabasawa describes an inner yoke in the form of yoke 14 that is positioned inside of the cavity defined by focus coil 7a and/or focus coil 7b (first coils). Kabasawa, Table on p. 3, ¶49, Fig. 1. As shown in annotated Figure 1 below, the yoke 14 in each cavity has two walls that are opposite the tracking coils 8a to 8d (second coil). In particular, each section that is highlighted in green as a whole can be considered a wall (making the two of them “a pair of first walls.”) In that case, as annotated in Figure 1 below for the lower inner yoke, the two walls are placed opposite to the tracking coils 8c and 8d (second coil), and those walls are separated from each other in the second direction. The same is true for the inner yoke in the upper part of the figure, where the two walls are disposed opposite to tracking coils 8a and 8b (second coil), and are separated in the second direction.

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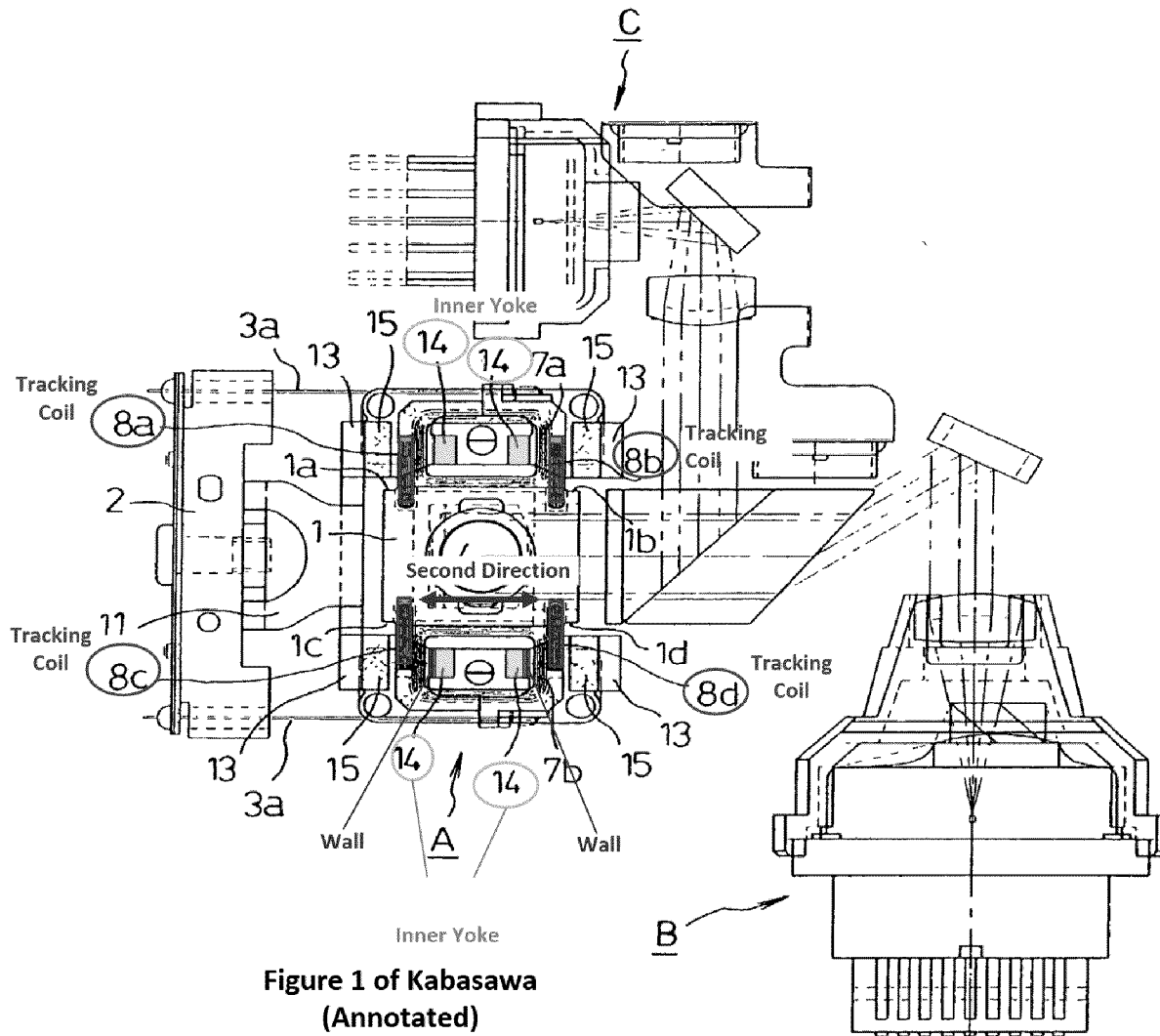


**Figure 1 of Kabasawa
(Annotated)**

205. Alternatively, “a pair of first walls” can be defined using one wall from each of the two green highlighted inner yoke sections. This is shown in the annotated Figure 1 below, where the pair of first walls is highlighted in red. The pair of first walls in this mapping are also disposed opposite the second coil (tracking coils 8c and 8d) and are separated from each other in the second direction, as shown in the figure below. The same is true for the inner yoke in the upper part of the figure,

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where the two walls are disposed opposite to tracking coils 8a and 8b (second coil)
and are separated in the second direction.



3. **Claim 21: The optical pickup actuator according to claim 17, further comprising a pair of unipolar magnets disposed opposite each other with respect to the blade in the second direction and have the same polarity.”**

206. Kabasawa describes a pair of magnets 15 that are disposed opposite each other in the second direction, as shown in annotated Figure 1 below. Kabasawa, Table on p. 3, ¶49, Fig. 1. The magnets 15 interact with the focus coils 7a, 7b and with the tracking coils 8a-8d. Kabasawa, ¶49.

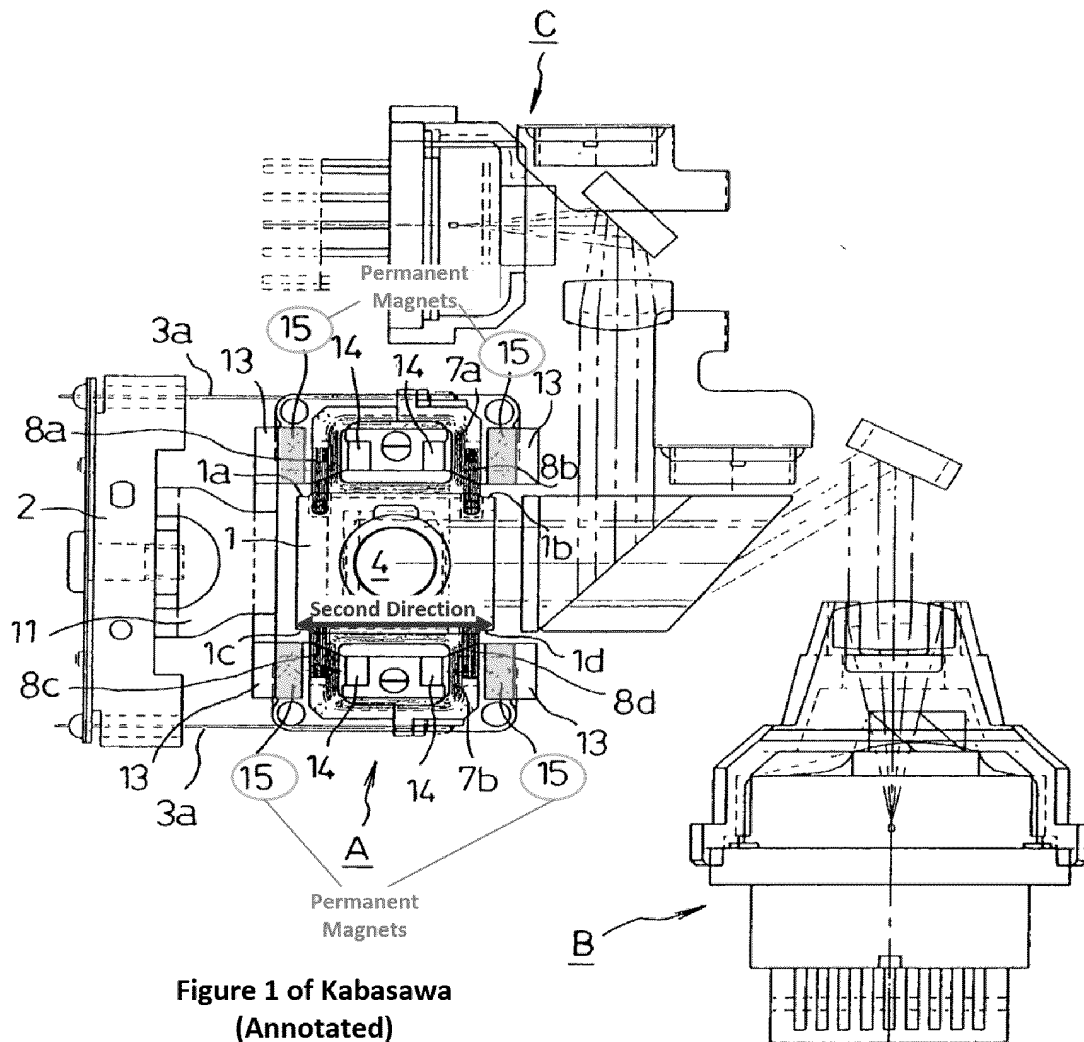


Figure 1 of Kabasawa
(Annotated)

207. It would have been obvious to a POSITA that Kabasawa's magnets 15 were unipolar (i.e., had a single pole facing the focus and tilting coils) for the same reasons I discussed in connection with claims 7 and 8 in Ground 1.

4. Claim 23: The optical pickup actuator according to claim 17, wherein the second coil is positioned vertically on both sides of the blade in the second [direction]."

208. Kabasawa discloses this claim because, as shown in its Figure 1 (annotated below), its tracking coils 8a-8d (second coil) are positioned vertically on both sides of the lens holder 1 (blade) in the second direction. Kabasawa, Abstract, ¶¶44, 50, Fig. 1.

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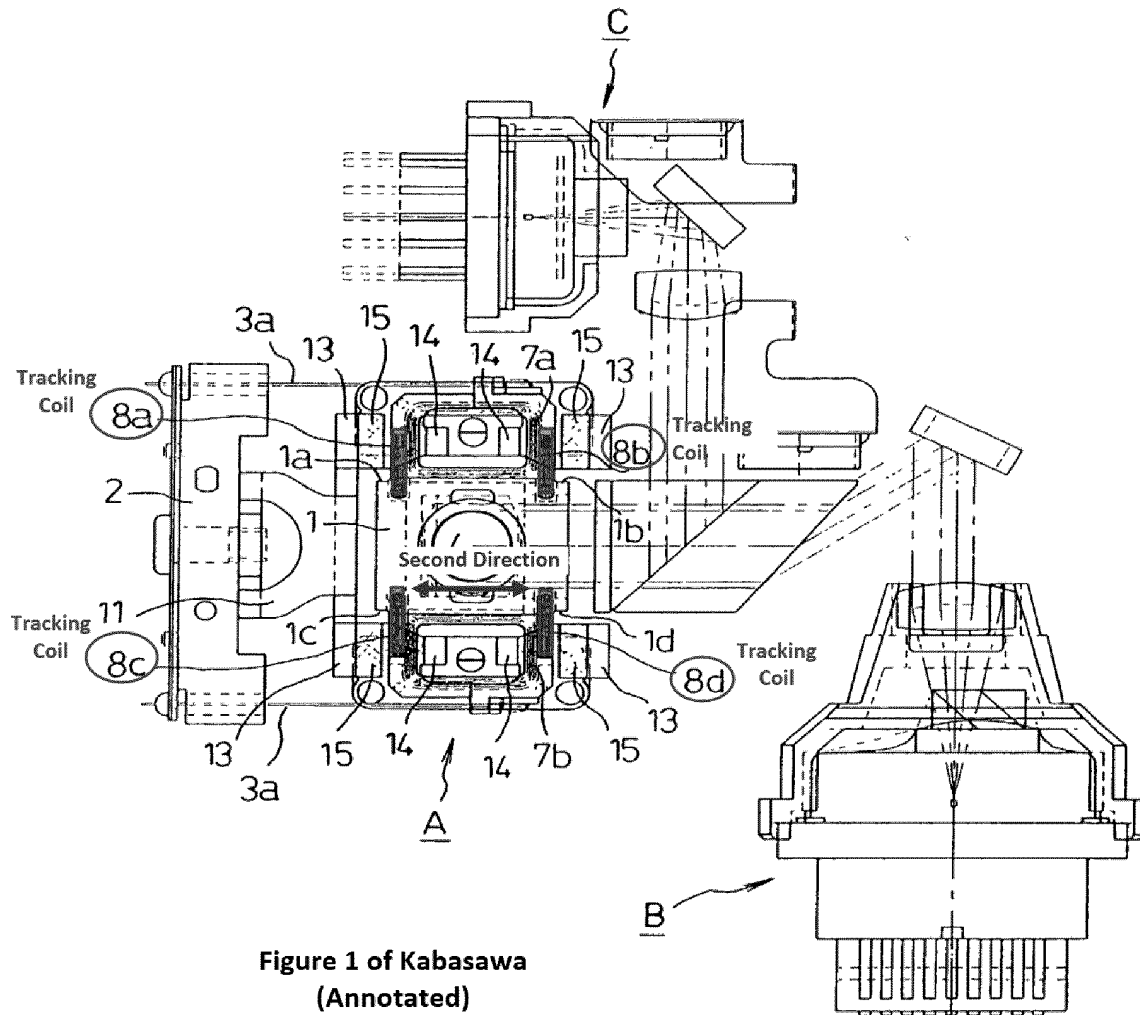
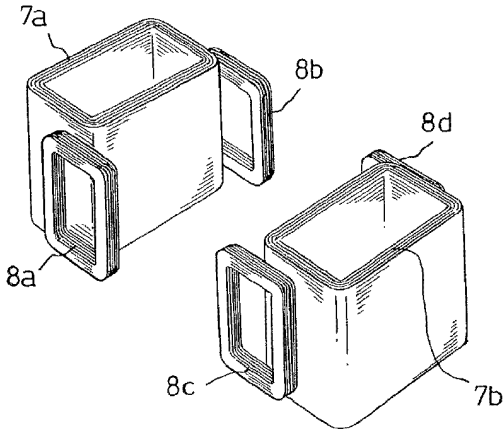


Figure 1 of Kabasawa
(Annotated)

209. In particular, the pair of coils 8a and 8b (and similarly 8c and 8d) are positioned vertically on both sides of the blade in the second direction. See also Fig. 6 showing vertical positioning of tracking coils 8a/b and 8c/d.

Fig. 6



5. Claim 24

a. 24[pre]: “An optical disc drive for a disc that is a recording medium, comprising:”

210. Kabasawa teaches or suggests this limitation because it described an optical disk apparatus for reproducing record of or recording information in an optical disk recording medium, such as a CD or a DVD, that could be implemented in a PC or a notebook computer. Kabasawa, ¶¶2, 4-5, 20, 33, Fig. 1.

b. 24[a]: “a spindle motor for rotating the disc;”

211. Kabasawa teaches or suggests a spindle motor for rotating the disc because it describes a “rapidly rotating” optical disk, wherein light beams that are reflected from the recorded pits on the disk are detected to read those recorded bits. Kabasawa, ¶¶5-8. It would have been obvious to a POSITA that a spindle motor would be used to rotate the disc because a spindle motor was a routine and known

element for causing a disk to rotate in a disk drive. Additionally, a spindle motor for rotating the disc is an Applicant Admitted Prior Art (AAPA) because it was described in the '055 patent as part of prior art systems. Ex. 1001, 1:21-26; 3:5-8.

c. 24[b]: “an optical pickup for recording and/or reproducing information by emitting light focuses onto the disc through an objective lens; and;”

212. Kabasawa discloses an optical pickup because it describes an optical pickup apparatus including various optical components for recording or reproducing information on optical storage media. Kabasawa, Abstract, ¶¶33, 43, Fig. 1; *see also* element 24[pre]. Kabasawa’s optical pickup apparatus also describes an objective lens 4 (see Element 17[b], above), wherein light is transmitted through the objective lens to the optical disc for reading the recorded bits. Kabasawa, ¶¶5-8, 20, 26, 43; Fig. 1.

213. For example, Kabasawa describes the general concept that applies to many optical disc drives: “a light beam emitted from an semiconductor laser device 101 transmits a beam splitter 102 and enters an objective lens 104 installed in a lens holder 103. Then, this objective lens 104 collects the light beam and spots of beam are formed in fine pits formed on a recording surface of an optical disk D.” Kabasawa, ¶5. The description of Kabasawa is similar to the explanations in the '055 patent about its optical pickup (Ex. 1001, 6:6-11), as I explained in paragraph 87 of this declaration, which was also very well-known to a POSITA.

214. Also, it would have been obvious that the objective lens focused the light onto the recorded medium because Kabasawa describes focusing coils and other techniques for improving “focus characteristics.” Kabasawa, ¶56; see also, *id.*, ¶¶17, 44. Additionally, this limitation is obvious as an AAPA. See Ex. 1001, 1:20-46.

- d. **24[c]: “an optical pickup actuator for controlling a position of the objective lens so that the emitted light is focused on a desired position of the disc, the optical pickup actuator comprising:”**

215. Kabasawa describes an optical pickup actuator as explained in connection with the preamble of claim 17. See Element 17[pre], above.

- e. **24[d]: “a blade holding the objective lens and supported on a base by a plurality of suspension wires so that the blade is elastically movable,”**

216. See Elements 17[a] and 17[b], above.

- f. **24[e]: “a pair of first coils positioned horizontally on the blade and disposed opposite each other with respect to the objective lens in a first direction,”**

217. See Element 17[c], above.

- g. **24[f]: “a second coil positioned vertically on a side of the blade in a second direction perpendicular to the first direction, and”**

218. See Element 17[d], above.

- h. 24[g]: “an inner yoke positioned on the base, the inner yoke positioned inside a cavity formed by walls of each of the first coils, wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.”**

219. See Element 17[e], above.

- 6. Claim 28: “The optical disc drive according to claim 24, wherein the optical pickup actuator further comprises a pair of unipolar magnets disposed oppo-site to each other with respect to the blade in the second direction and have the same polarity.”**

220. See Claim 21, above.

I. Ground 9: Miura alone or in view of AAPA when combined with Kamata renders obvious claims 17, 19, 23-24 and 26

1. Brief Description of Miura (Ex. 1009)

221. Miura (Ex. 1009) is a Japanese Patent Publication No. JP2000123386A, titled “Optical Lens Driving Device,” and was published on April 28, 2000. Miura strives to make the “whole optical pickup of an optical disk drive thinner while maintaining an excellent dynamic characteristic of an object lens driving device.” Miura, Abstract. Miura’s optical pickup apparatus includes, among others, an objective lens 1, two focus coils 3, tracking coils 4, tilt coil 9, and inner yokes (50b, 51b). Miura, Abstract, 233-234, Figs. 5 and 6.

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2. Claim 17

a. 17[pre]: “An optical pickup actuator for use with an objective lens on a base, comprising:”

222. Miura describes an optical pickup actuator as shown in its Figure 5 and 6 (annotated below): “Fig. 5 is a front cross-section view of an objective lens drive apparatus according to the 5th embodiment of the invention, Fig. 6 is a front cross-section view of the configuration ... [showing that] a tilting coil 9, for tilting objective lens 1 radially to the direction of the optical disc, is arranged on the movable section, and magnets 6c and 6d, for generating magnetic flux acting on tilting coil 9, are arranged on the fixed section” Miura, 293-297.

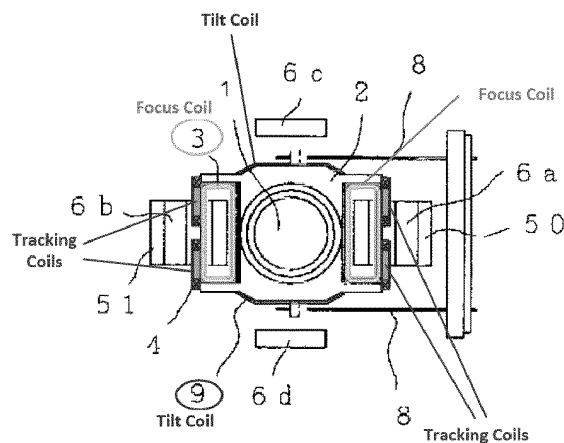


Figure 5 of Miura
(annotated)

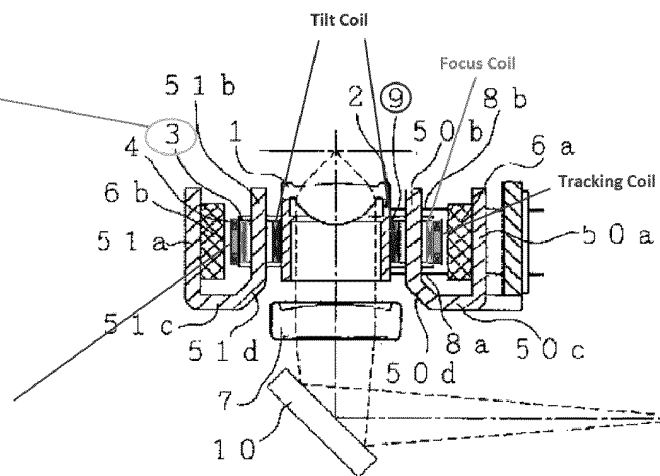


Figure 6 of Miura
(annotated)

b. 17[a]: “a blade holding the objective lens;”

223. Miura describes a blade in the form of a lens holder 2 (see annotated Figure 5 below) that holds an objective lens 1. Miura, claim 1, Fig. 5.

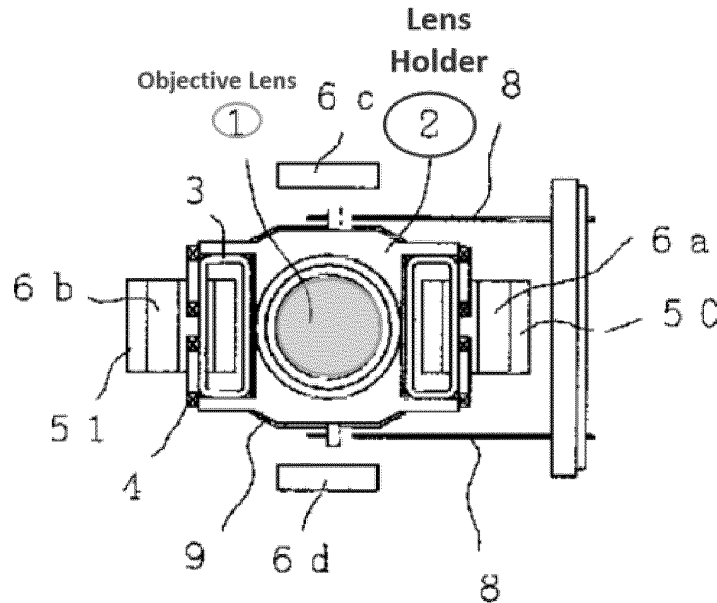


Figure 5 of Miura
(annotated)

- c. 17[b]: “a plurality of suspension wires supporting the blade on the base so that the blade is elastically movable;”

224. Miura describes a plurality of suspension wires in the form of elastic support members 8, as shown in annotated Figure 5 below. The elastic support members allow the blade to be elastically movable because it “is fixed to one end of said movable section, and that *elastically supports said movable section.*” Miura, 32-33; see also *id.*, 220-223: “In Fig. 1, objective lens 1, focusing coil 3 and tracking coil 4 are arranged in lens holder 2. A movable section is supported by a plurality of elastic support members 8, and one end of each of these elastic support members 8

is mechanically connected and fixed to the movable section, and the other end to the fixed section.”

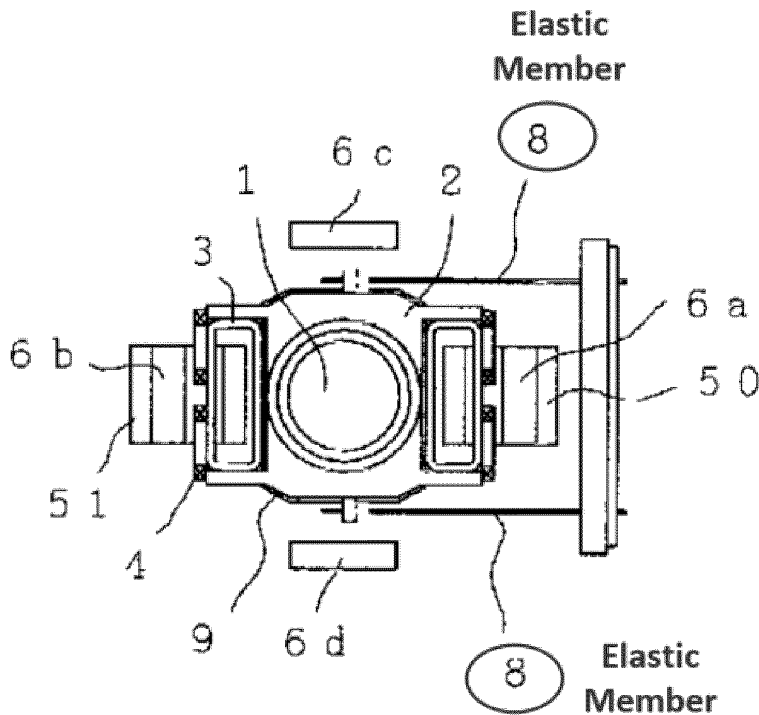
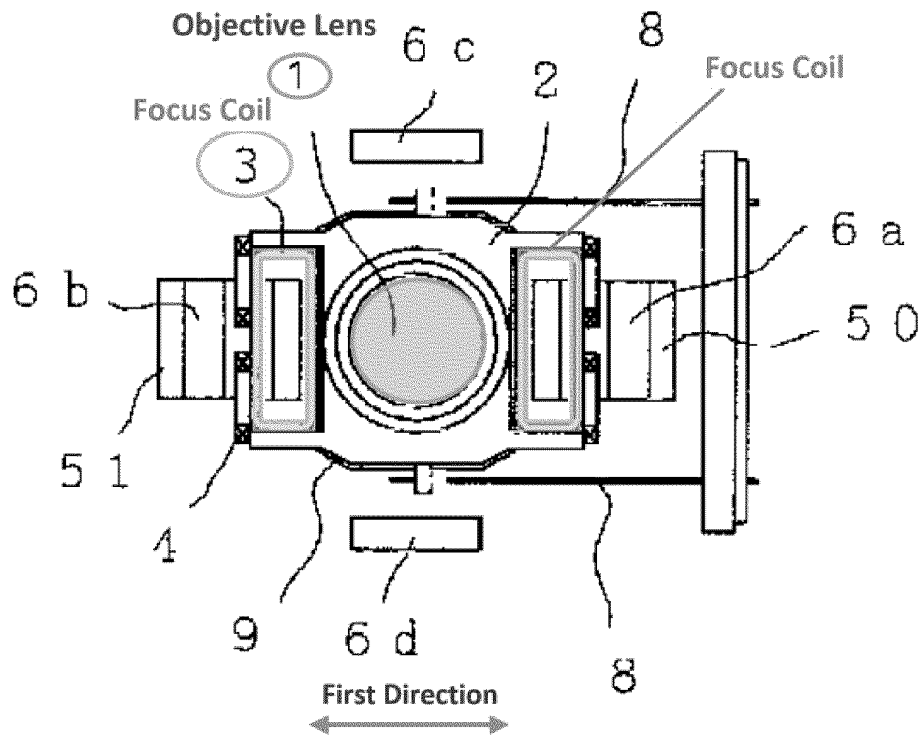


Figure 5 of Miura
(annotated)

- d. 17[c]: a pair of first coils positioned horizontally on the blade and disposed opposite each other with respect to the objective lens in a first direction;”

225. Miura describes a pair of first coils in the form of focus coils 3, as shown in annotated Figure 5. Miura specifically describes the focus coils 3 in connection with Figure 1, but the same labeling convention is used for Figures 5 and 6. See Miura, 339; see also, *id.*, 220: “In Fig. 1, objective lens 1, focusing coil 3 and tracking coil 4 are arranged in lens holder 2.” As shown in Figure 5 below, the

focus coils 3 (pair of first coils) are positioned horizontally on the blade and are opposite each other with respect to the objective lens 1 in a first direction. See also Ground 1, Element 1[d], for explanation of “horizontal” configuration of the coils.



**Figure 5 of Miura
(annotated)**

- e. **17[d]: “a second coil positioned vertically on a side of the blade in a second direction perpendicular to the first direction; and”**

226. Miura describes a second coil in the form of tracking coils 4, as shown in annotated Figures 5 and 6 below (purple). Specifically, the two tracking coils 4 on the left side of the lens holder in Figure 5 are the second coil positioned vertically

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on the (left side of) lens holder (blade) and positioned in the second direction (as annotated). The second direction is perpendicular to the first direction. Additionally or alternatively, the tracking coils on the right of the lens holder can be construed as the second coil positioned vertically on the (right side of) the lens holder in the second direction.

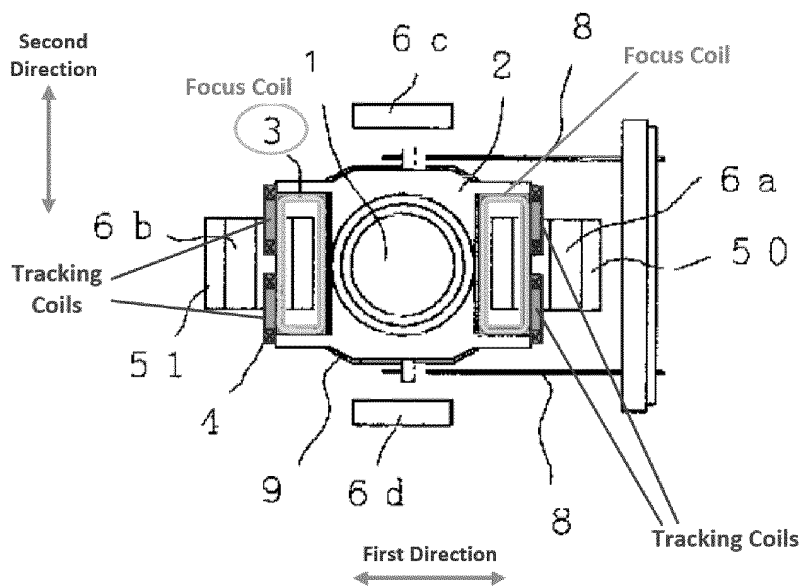


Figure 5 of Miura
(annotated)

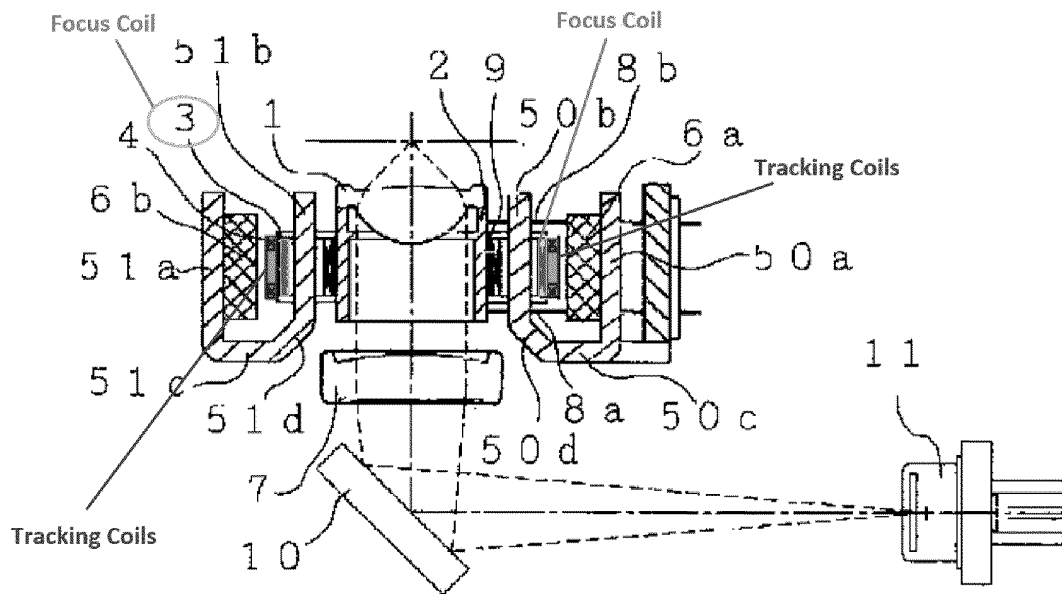


Figure 6 of Miura
(annotated)

- f. 17[e]: “an inner yoke positioned on the base, the inner yoke positioned inside a cavity defined by each of the first coils, wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.”

227. Miura describes an inner yoke in the form of yokes 50b and/or 51b that are positioned inside of the cavity defined by each of the focus coils 3 (first coils), as shown in annotated Figures 5 and 6 below. See also, Miura, Abstract (explaining internal yokes 50b, 51b having walls extending in the direction of the objective lens optical axis, and *id.*, 298-299: “... inner yokes 50b, 51b and yoke undersides 50c, 51c are connected through inclined sections 50d, 51d.”

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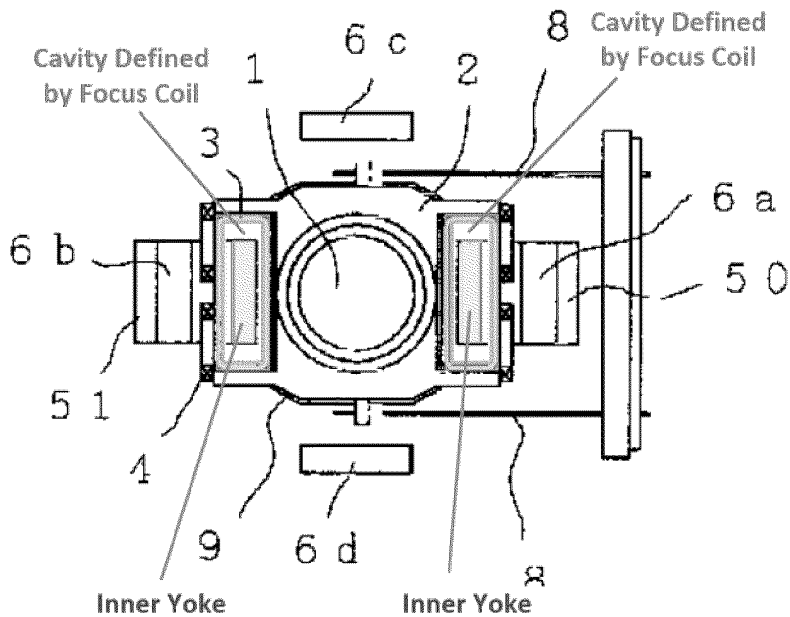


Figure 5 of Miura
(annotated)

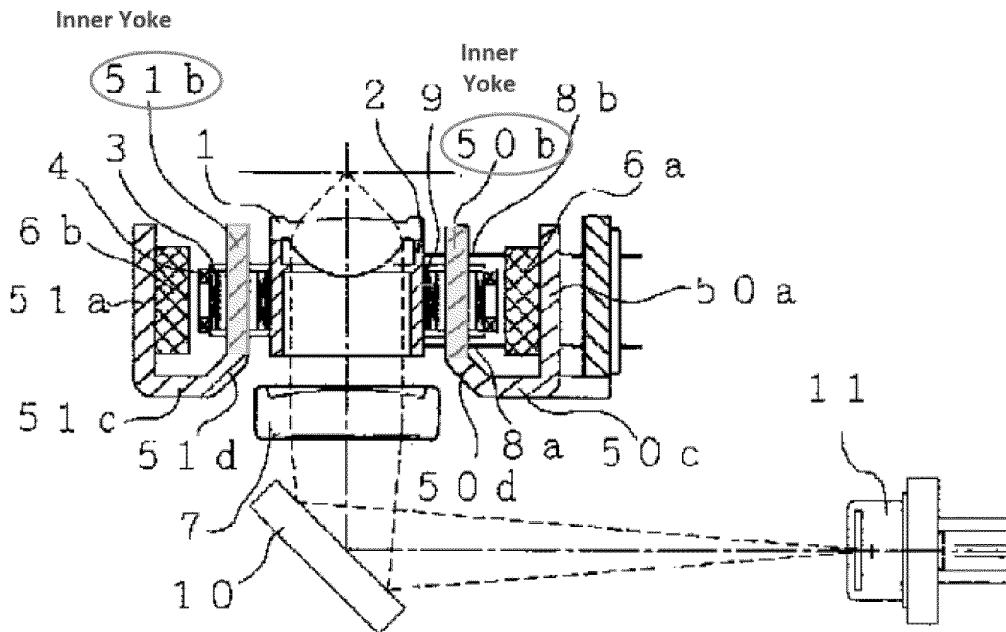


Figure 6 of Miura
(annotated)

228. The remaining limitations of element 17[f] would have been obvious based on the combination of Miura and Kamata. As I explained in Ground 7, Kamata describes that its optical pickup actuator includes “a magnet and a yoke having opposing surfaces facing each other with the focus coil and tracking coil therebetween.” Kamata, 36-37. Kamata’s yoke is shown in Figure 2 (annotated below).

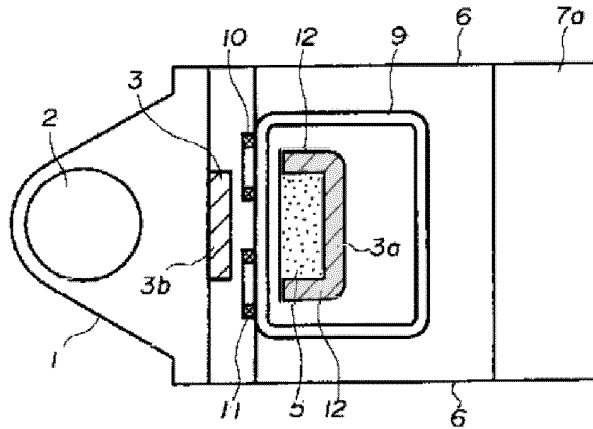
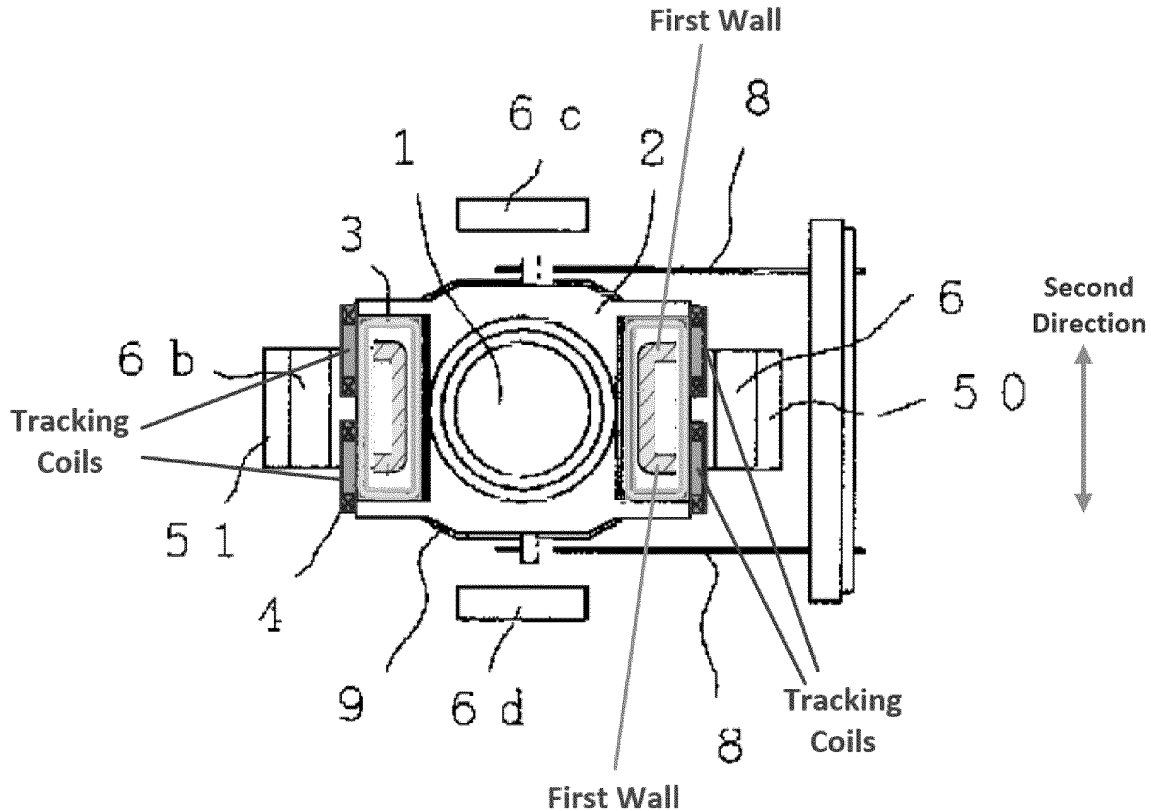


Figure 2 of Kamata (annotated)

229. Kamata improved on prior systems where “... there is [] magnetic flux directed obliquely to the tracking coils 10 and 11 from both sides of the permanent magnet 5, so that the magnetic flux density distribution on both sides of the tracking coils 10 and 11 is in an unbalanced state.” Kamata, 68-71. Kamata’s solution entails using a yoke with two bent sections (as shown in Figure 2) that “reduce the magnetic flux directed obliquely from the permanent magnet 5 to both the tracking coils 10 and 11.” Kamata, 121-124.

230. As a result, a more uniform magnetic field density around the tracking coils is generated, and the undesirable rotational movements of the lens holder are eliminated. Kamata, 153-155; see also, *id.*, 89-90: “Providing such an auxiliary yoke eliminates the imbalance of magnetic flux densities on both sides of the tracking coil, thereby preventing undesired rotational motion from being induced in the movable part.”

231. In the combination, a POSITA would have found it obvious to include the inner yoke of Kamata with the bent side walls in place of Miura’s inner yoke. In the combination, the inner yoke includes a pair of first walls that are separated in the second direction (see below illustration).



**Illustration - Figure 5 of Miura
 Combined with Inner Yoke of Kamata**

232. A POSITA would have been motivated to combine Miura and Kamata (both relating to optical pickup devices) because Kamata had recognized a problem in prior art systems that used two adjacent tracking coils, such as those shown in Kamata's Figure 7 (which is similar to Miura's Figure 5 placement of tracking coils), and thus produced an unbalanced magnetic field around the tracking coils. Kamata, 68-71. A POSITA would have therefore been motivated, and would have found it obvious, to apply Kamata's solution to Miura by implementing an inner yoke with two bent ends (as shown in Kamata's Figure 2) to remove the undesirable rotational

movements. Kamata, 89-90, 121-124, 153-155. This would have improved the magnetic field uniformity of Miura's tracking coils, and enhanced the operation of the optical pickup.

233. Making the combination involved routine mechanical modifications well within the capabilities and knowledge of a POSITA.

3. Claim 24

a. 24[pre]: "An optical disc drive for a disc that is a recording medium, comprising:"

234. Miura teaches or suggests the preamble limitation because it describes an "an objective lens drive apparatus used in an optical disc apparatus" (Miura, 93-94), where objective lens "concentrates an optical beam on an optical disc." Miura, 29. Miura also explicitly describes: "optical beam spot focused by objective lens 1 to always be positioned on the optical disc's recording surface track" (Miura, 252-253), which conveys to a POSITA that Miura's optical pickup is for recording medium (optical disc).

b. 24[a]: "a spindle motor for rotating the disc;"

235. Miura teaches or suggests a spindle motor for rotating the disc at least because it describes tracking coils in an optical disc drive. Miura, 249-253. This, and other descriptions of the components of an optical disc drive, would have informed a POSITA that such tracking coils were provided for tracking the recorded

information on tracks of a rotating disk. This is a fundamental feature of an optical disc drive known to a POSITA, and so is using a spindle motor for rotating the disc. In fact, the '055 patent's background already described using a spindle motor for rotating the disc is part of prior art systems. Ex. 1001, 1:21-26; 3:5-8. Therefore, this limitation was obvious and Applicant Admitted Prior Art (AAPA).

c. 24[b]: “an optical pickup for recording and/or reproducing information by emitting light focuses onto the disc through an objective lens; and;”

236. Miura explains that its objective is to “provide an objective lens drive apparatus that is capable of making the entire *optical pickup* thinner, while maintaining good dynamic characteristics.” Miura, 15-16; see also, *id.*, 121-122. Therefore, Miura clearly states its optical disc apparatus included an optical pickup. Miura also describes an objective lens 1 (see Element 17[b], above) that “concentrates an optical beam on an optical disc.” Miura, 29. Miura further explains that “optical beam spot focused by objective lens 1 to always be positioned on the optical disc’s recording surface track” (Miura, 252-253), which conveys to a POSITA that Miura’s optical pickup is for recording or reproducing information via the focused light. Additionally, this limitation is obvious both to a POSITA (see paragraph 26) and as an AAPA. *See* Ex. 1001, 1:20-46.

- d. **24[c]: “an optical pickup actuator for controlling a position of the objective lens so that the emitted light is focused on a desired position of the disc, the optical pickup actuator comprising:”**

237. See Element 17[pre], above.

- e. **24[d]: “a blade holding the objective lens and supported on a base by a plurality of suspension wires so that the blade is elastically movable,”**

238. See Elements 17[a] and 17[b], above.

- f. **24[e]: “a pair of first coils positioned horizontally on the blade and disposed opposite each other with respect to the objective lens in a first direction,”**

239. See Element 17[c], above.

- g. **24[f]: “a second coil positioned vertically on a side of the blade in a second direction perpendicular to the first direction, and”**

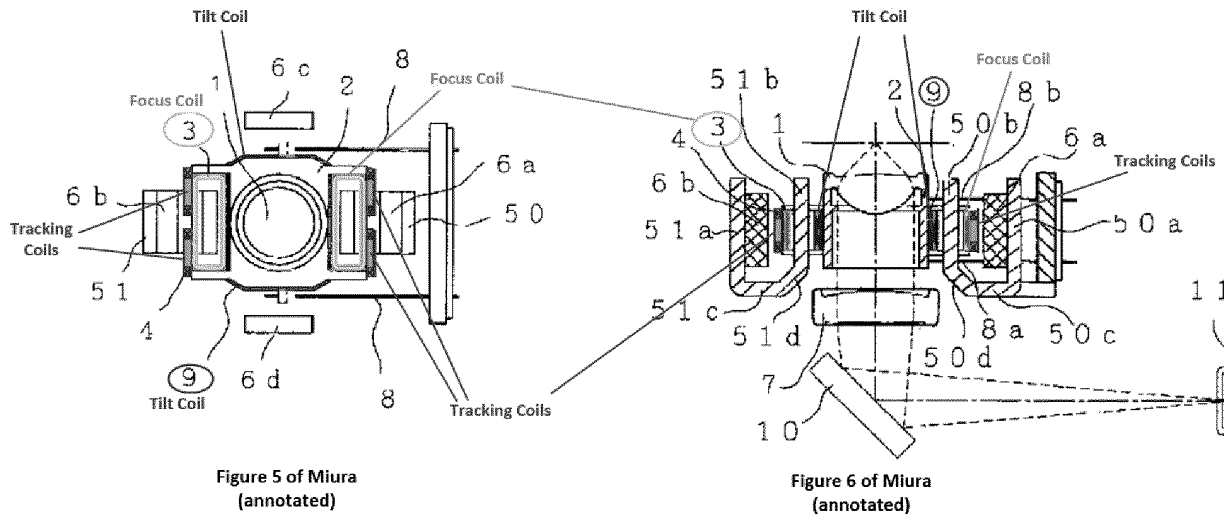
240. See Element 17[d], above.

- h. **24[g]: “an inner yoke positioned on the base, the inner yoke positioned inside a cavity formed by walls of each of the first coils, wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.”**

241. See Element 17[e], above.

4. **Claims 19 [26]: “The optical pickup actuator according to claim 17, further comprising [The optical disc drive according to claim 24, wherein the optical pickup actuator further comprises] a third coil positioned so as to surround the sides of the blade.”**

242. Miura describes a third coil in the form of tilt coil 9, as shown in annotated Figures 5 and 6 below. The combination with Kamata does not affect the placement of the tilt coil, and thus original Figures 5 and 6 of Miura are used to illustrate the positioning of the tilt coil.



243. A POSITA would have found it obvious that Miura’s tilt coil 9 surrounds the sides of the blade because the tilt coil surrounds the top and bottom sides (“the sides”) of the lens holder (blade) in Figure 5 (annotated below).

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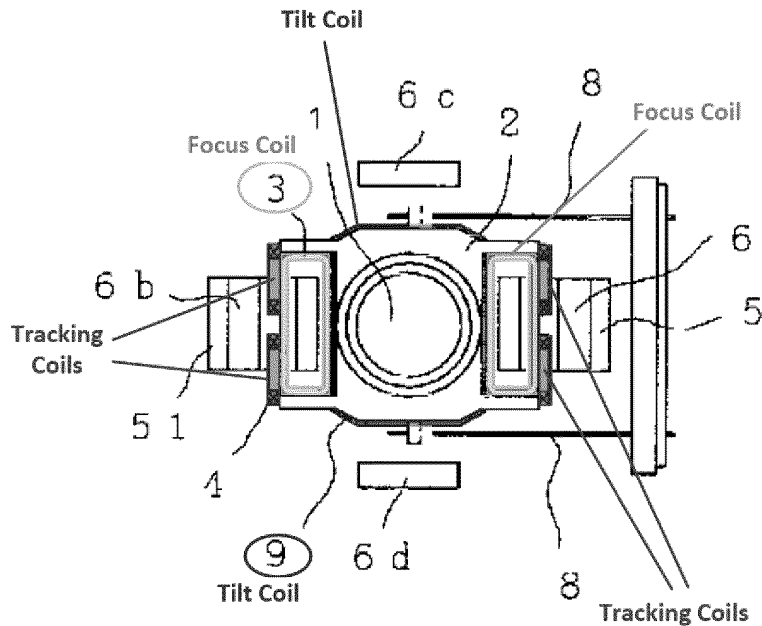
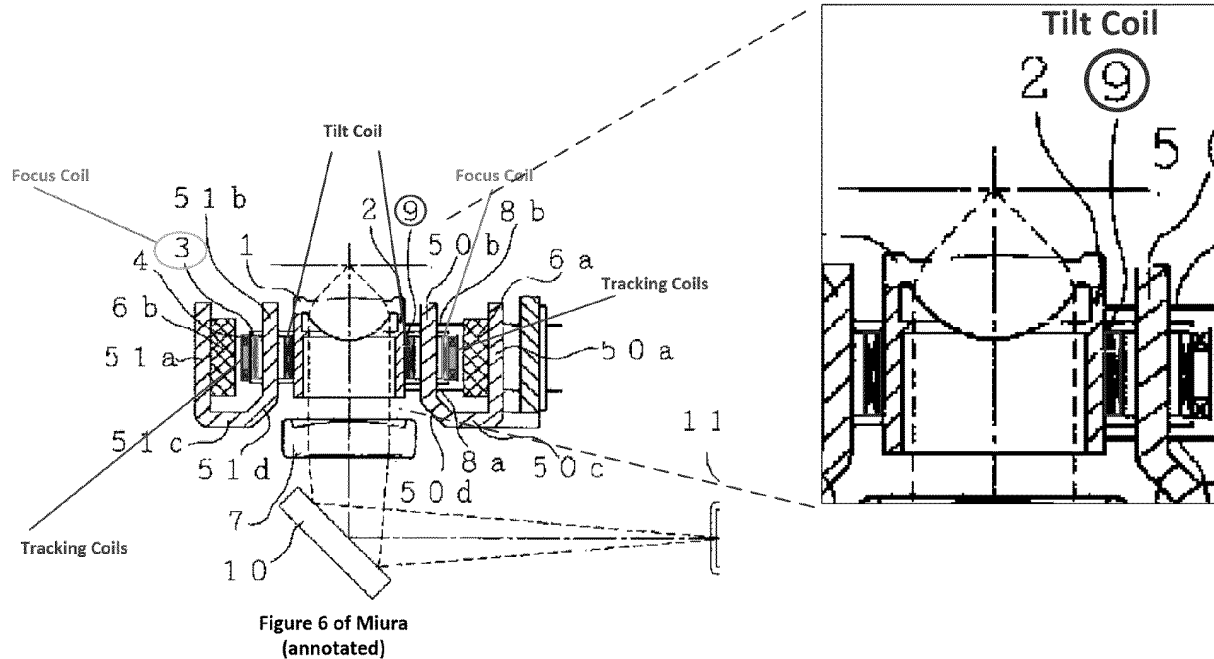


Figure 5 of Miura
(annotated)

244. Additionally, Figure 6 of Miura shows a front *cross-sectional view* (Miura, 294-295), where all three coils (focus coil 3, tracking coils 4 and tilt coil 9) are visible. See annotated Figure 6 below. A POSITA would have found it obvious that the tilt coil 9 not only occupies the top and bottom sides of the lens holder, but in fact fully wraps around the lens holder because otherwise it would not have been visible in the cross-sectional view of Figure 6. A POSITA would have also understood that the tilt coil 9 must comprise a single continuous loop of wire (i.e., a solenoid), otherwise it cannot carry the electric current. Miura's Figures 5 and 6 show four segments of the tilt coil 9. These four segments must be sequentially connected to each other in order to produce a continuous current-carrying loop. The

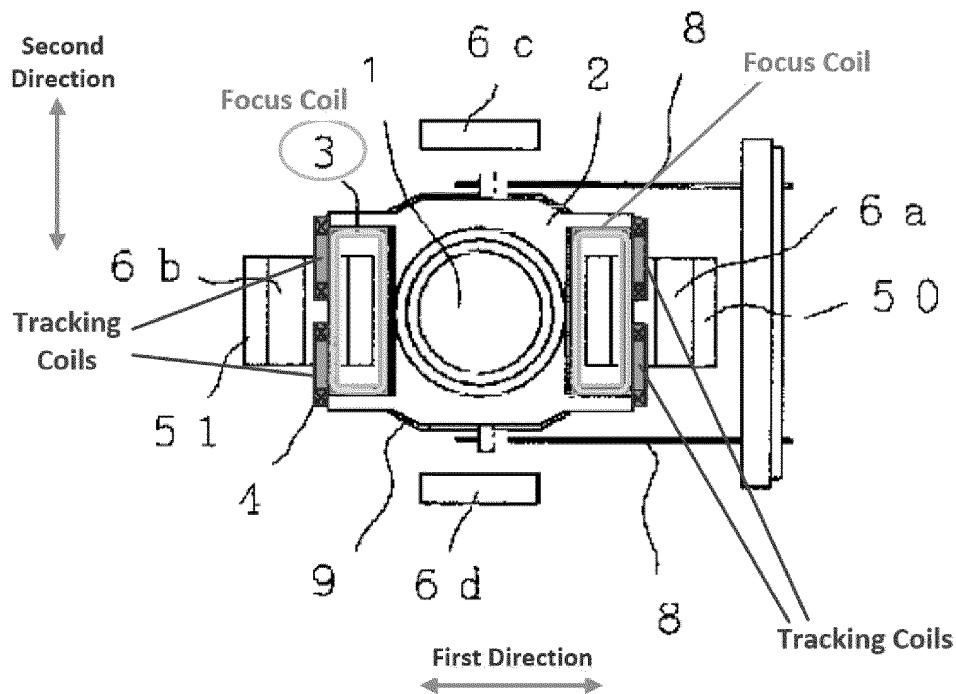
only logical way in which these four pieces of wire could form a continuous loop is for them to fully surround the lens holder.



5. Claim 23: “The optical pickup actuator according to claim 17, wherein the second coil is positioned vertically on both sides of the blade in the second [direction].”

245. Miura disclosed this limitation as shown in its Figure 5 (annotated below). The combination with Kamata does not affect the placement of the tracking coils, and thus original Figure 5 of Miura is used to illustrate the position of the tracking coils. Specifically, the tracking subcoils 4 (second coil) are positioned on both sides of the lens holder 1 (blade), and they are positioned in the second direction, as shown in annotated figure below. The two tracking coils on the left side of the lens holder are placed vertically and are separated in the second direction,

and the two tracking coils on the right side of the lens holder are placed vertically and are separated in the second direction.



**Figure 5 of Miura
(annotated)**

**J. Ground 10: Sugiyama alone or in combination with AAPA
Renders Obvious Claims 1, 3-4 and 10, 12-13.**

1. Brief Description of Sugiyama (Ex. 1010)

246. Sugiyama (Ex. 1010) is Japanese Patent Publication No. JP2001118269A, titled “Optical Lens Driving Device,” which was published on April 27, 2001. Sugiyama relates to “an objective lens driving device capable of stably writing in to and reading out from an optical disk by holding a [] relative angle

between the objective lens and the optical disk always constant.” Sugiyama, Abstract. Sugiyama’s device includes, among others, “an objective lens 4, a focusing coil 6, a tracking coil 7, and a lens holder 5, a fixed section 8 that supports the movable section by means of elastic support members 9.” *Id.*, Fig. 1.

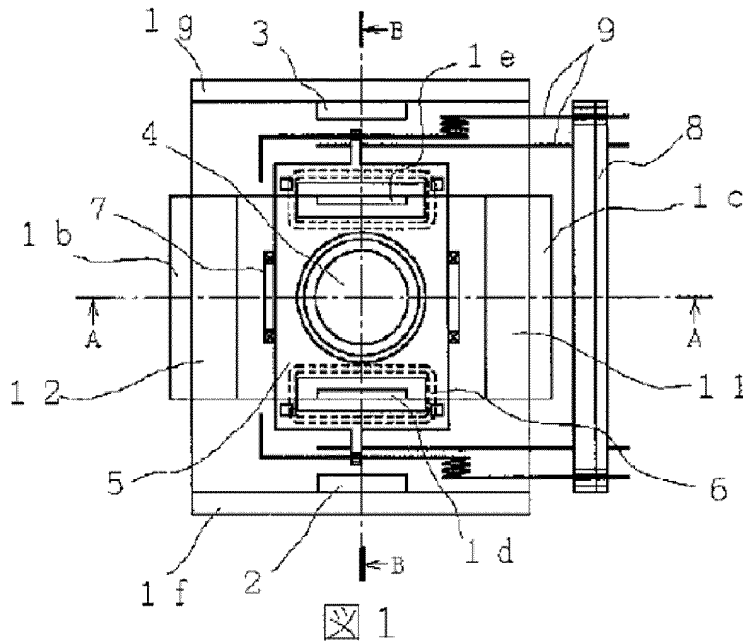


Figure 1 of Sugiyama

2. Claim 1

a. 1[pre]: “An optical pickup actuator for use with an objective lens on a base, comprising:”

247. Sugiyama describes an optical pickup actuator because it described “an objective lens drive for use in an optical disc device” that included a base 1a and an objective lens 4. Sugiyama, 93, 183-193; Fig. 1 and Fig. 2 (annotated below). The

objective lens moves in the tracking, focusing and tilt directions due to the force generated by the respective coils. Sugiyama, 28-35, 145-155.

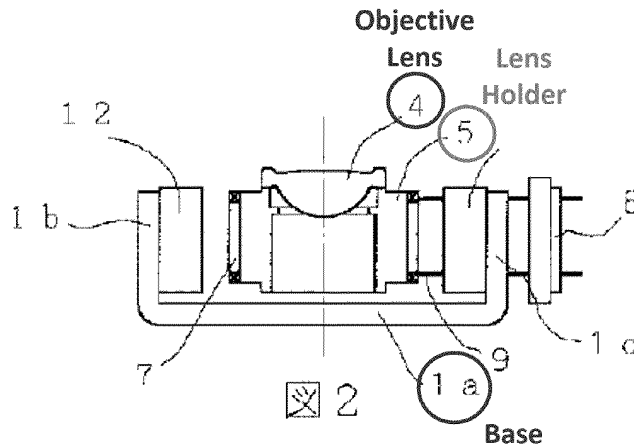


Figure 2 of Sugiyama
(annotated)

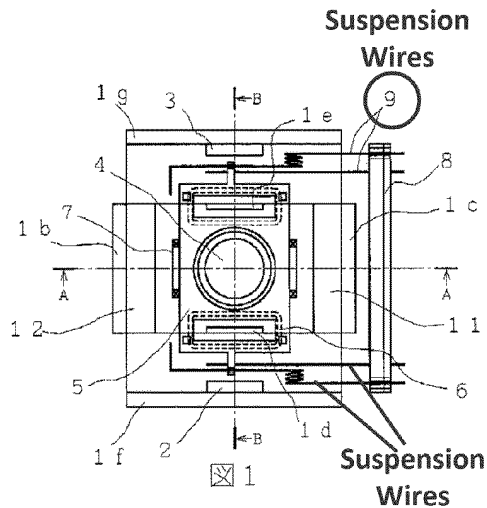
b. 1[a]: “a blade holding the objective lens;”

248. Sugiyama discloses a blade in the form of a lens holder 5, accommodating an objective lens 4, as shown in Figures 1 and 2. Sugiyama, 17-18, 148-149, 151-152; Fig. 1 (annotated below) and Fig. 2 (annotated above).

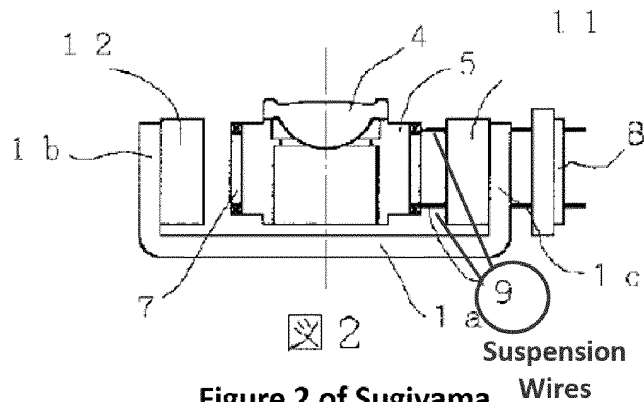
c. 1[b]: “a plurality of suspension wires supporting the blade on the base so that the blade is elastically movable;”

249. Sugiyama discloses this element because it describes a plurality of elastic support members 9 that support the movable part (lens holder or blade) on the base 1a. Sugiyama, 152-154: “...a plurality of elastic support members that are fixed to one end of and elastically support said movable section; a fixed section that is fixed to the other ends of said elastic support members.” See also Figures 1

and 2 (annotated below), and *id.*, 207-212: “Said movable section is supported by 6 ***conductive elastic support members 9***, with one end affixed to the movable section, and the other end to fixed section 8. Furthermore, said conductive elastic support members 9 are electrically connected respectively to focusing coils 6, tracking coils 7 and tilting coils 13 arranged in the movable section, and ***it is possible to supply current to focusing coils 6, tracking coils 7 and tilting coils 13 from fixed section 8 through conductive elastic support members 9.***”



**Figure 1 of Sugiyama
(annotated)**



**Figure 2 of Sugiyama
(annotated)**

d. 1[c]: “a magnetic element positioned on the base;”

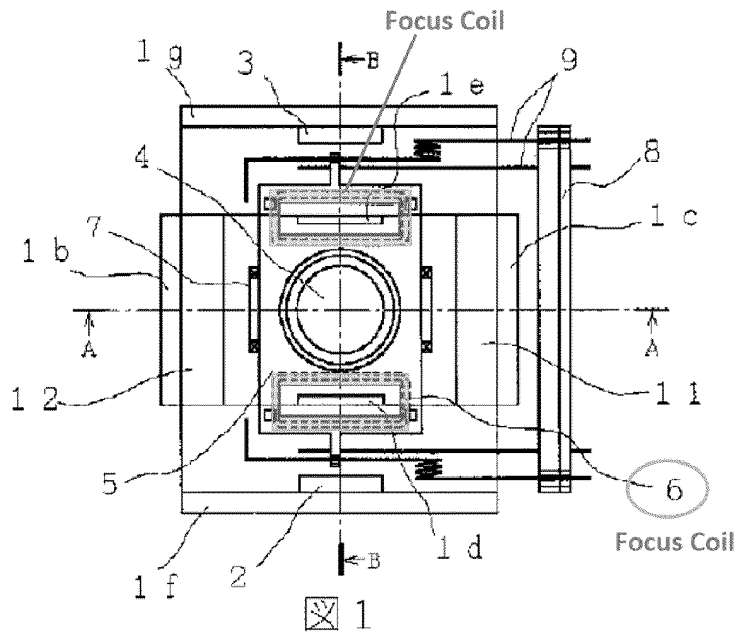
250. Sugiyama discloses this element because it describes four magnetic elements 2, 3, 11, 12 that are positioned on the base 1a (on yokes of the base). Sugiyama, 201-203: “... four raised sections 1b, 1c, 1g and 1f are disposed on

yoke 1, so as to surround said movable section on all four sides, and magnets 11, 12, 2 and 3 are arranged respectively on these raised sections.” See also, *id.*, 205-206, Figures 1 and 2. All magnetic elements 2, 3, 11 and 12 can be construed as the claimed magnetic element. However, Element 1[d] of claim 1 only requires interactions with magnetic elements 2 and 3, as explained below.

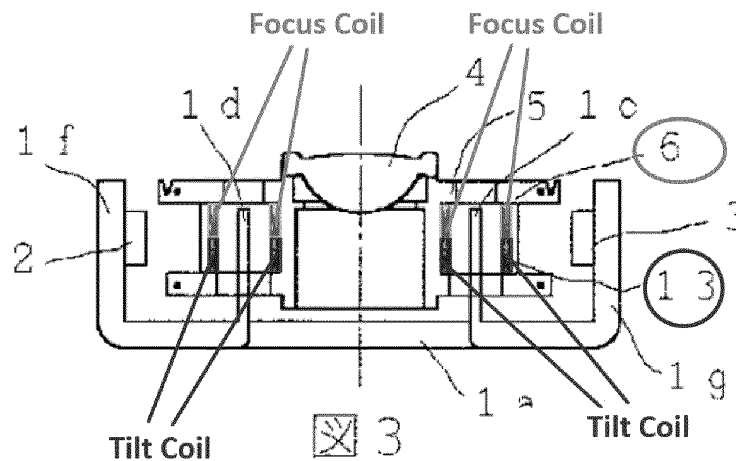
e. 1[d]: “a coil positioned horizontally on the blade to generate an electromagnetic force in a focusing and/or tilting direction through an interaction with the magnetic element;”

251. Sugiyama discloses this limitation because it describes two focus coils 6 and two tilt coils 13 that are positioned on the blade, as shown in Figures 1 and 3 (both annotated below). Sugiyama, 191-195: “A set of *focusing coils 6* is arranged symmetrically around the center of objective lens 4 on the side of lens holder 5 radially facing the optical disc. ... In addition, below said focusing coils 6, *tilting coil 13*, with a winding axis approximately coaxial with focusing coil 6, is adjacently arranged.”

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**Figure 1 of Sugiyama
(annotated)**



**Figure 3 of Sugiyama
(annotated)**

252. Focus and tilt coils of Sugiyama are positioned horizontally on the blade because they are positioned on the blade and the direction of their windings

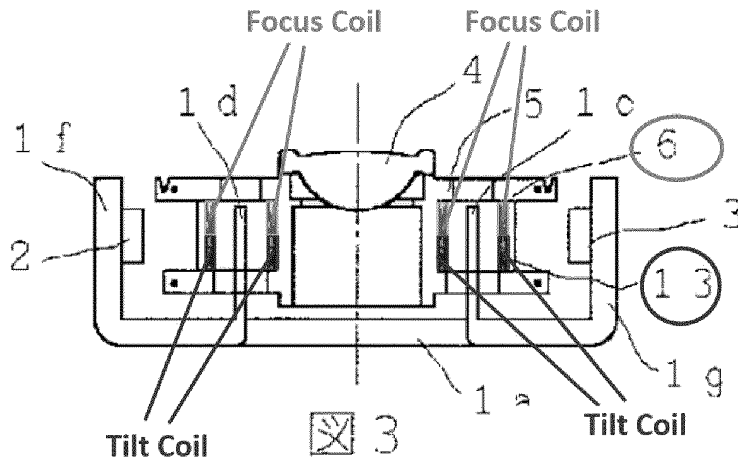
is parallel to the top surface of the blade, consistent with the '055 patent's description. See my explanations in Ground 1.

253. Sugiyama teaches or suggests that focus (6) and tilt (13) coils interact with magnetic elements 2 and 3 to generate an electromagnetic force because focus (6) and tilt (13) coils are positioned across from magnetic elements 2 and 3 (see Figures 1 and 3). Sugiyama further explains "...the signal from the tilt drive circuit supplies an adequate *tilt current to tilting coil 13*, making it possible to tilt the movable section; and this tilting action makes it possible to keep the relative angle between the optical disc and objective lens 4 constant." Sugiyama, 237-240; see also, *id.*, 229-230. Therefore, a POSITA would have understood that by supplying a current to the focus coils, they would generate an electromagnetic force in the focusing direction through interaction with the magnetic field of magnets 2 and 3; similarly, by supplying a current to the tilting coils, they would generate an electromagnetic force in the tilting direction, again through interaction with the magnetic field of magnets 2 and 3.

f. 1[e]: "wherein the coil is divided into a plurality of subcoils, where each subcoil is separated from an adjacent subcoil in a vertical direction, and;"

254. Sugiyama's coil is divided into subcoils: focus coil (6) and tilt coil (13) that are vertically separated: Sugiyama, 191-195: "A set of *focusing coils 6* is arranged symmetrically around the center of objective lens 4 on the side of lens

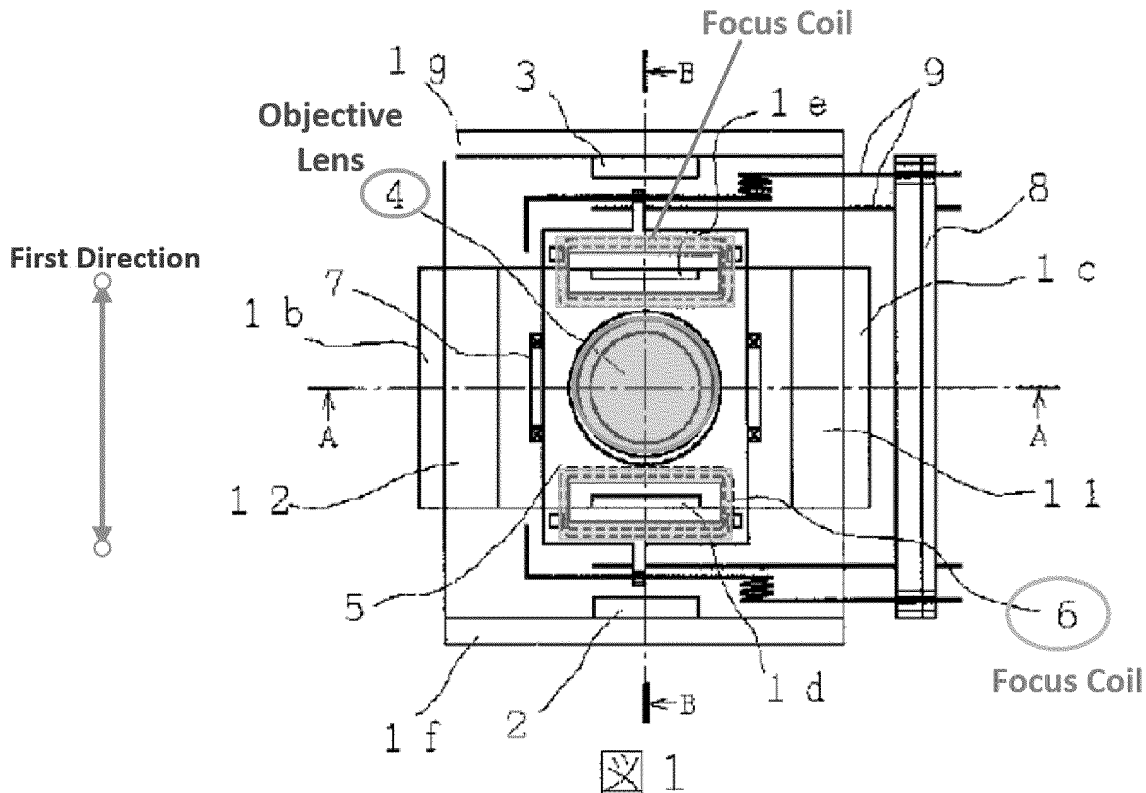
holder 5 radially facing the optical disc. ... In addition, *below said focusing coils 6, tilting coil 13, with a winding axis approximately coaxial with focusing coil 6, is adjacently arranged.*” See also, Figure 3 (annotated below). Accordingly, each focus subcoil is vertically separated from an adjacent tilt subcoil, and vice versa.



**Figure 3 of Sugiyama
(annotated)**

g. 1[f]: “wherein the coil comprises a pair of first coils positioned on the blade in a first direction and facing each other with respect to the objective lens.”

255. Sugiyama’s coil includes a first pair of coils, i.e., a pair of focus coils (6), which are positioned on the lens holder (5) in a first direction and face each other with respect to the objective lens (4), as shown in Figure 1 (annotated below); see also, Sugiyama, 191-192.

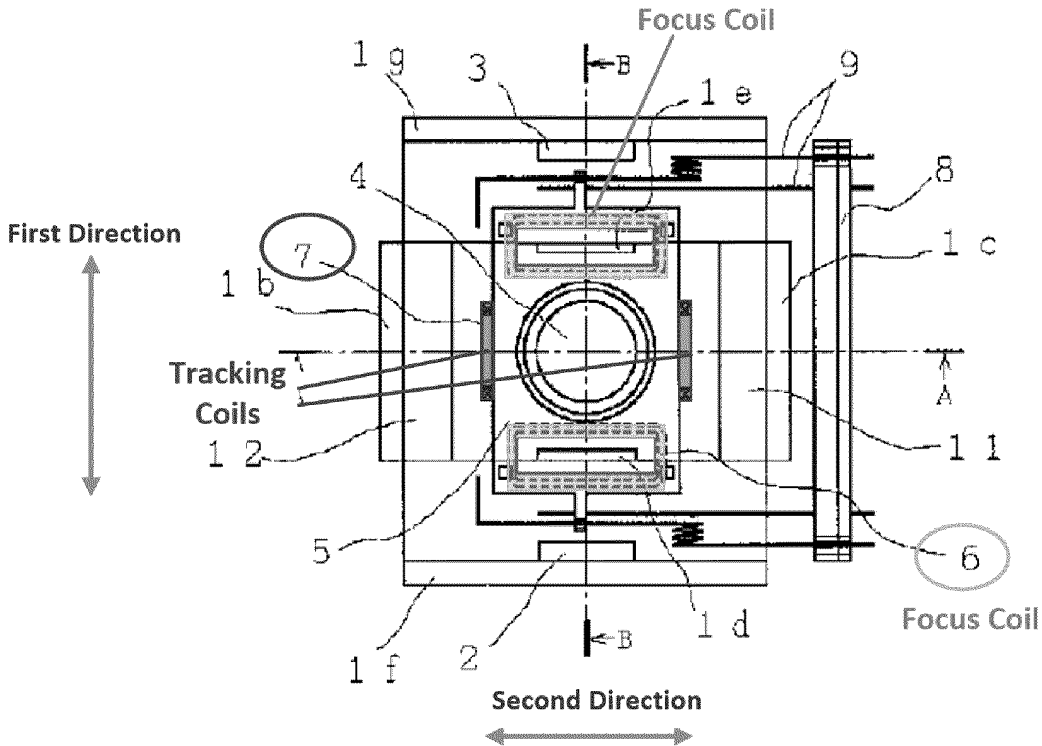


**Figure 1 of Sugiyama
(annotated)**

3. **Claim 3: “The optical pickup actuator according to claim 1, further comprising a second coil positioned vertically on a side of the blade in a second direction substantially perpendicular to the first direction, the second coil generating an electromagnetic force in a tracking direction through interaction with the magnetic element.”**

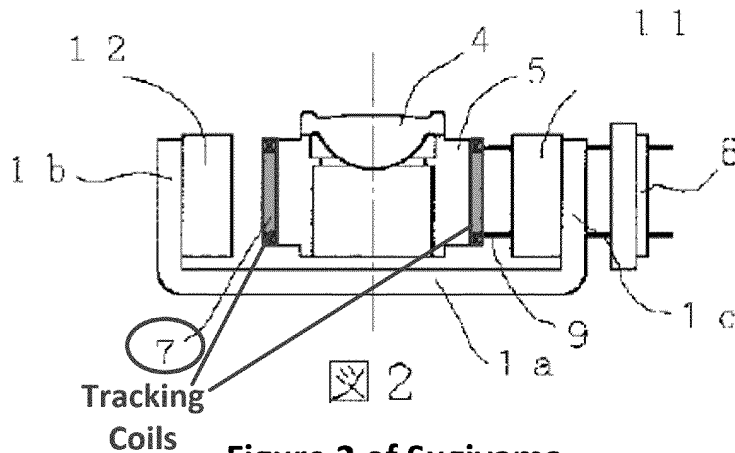
256. Sugiyama discloses the claimed second coil as tracking coils (7) that are positioned vertically along the sides of the blade, as shown in Figure 1 of Sugiyama (annotated below). See also, Sugiyama, 192-193: “... a set of tracking

coils 7 is arranged symmetrically around the center of objective lens 4 in the tangential direction of the optical disc.”



**Figure 1 of Sugiyama
(annotated)**

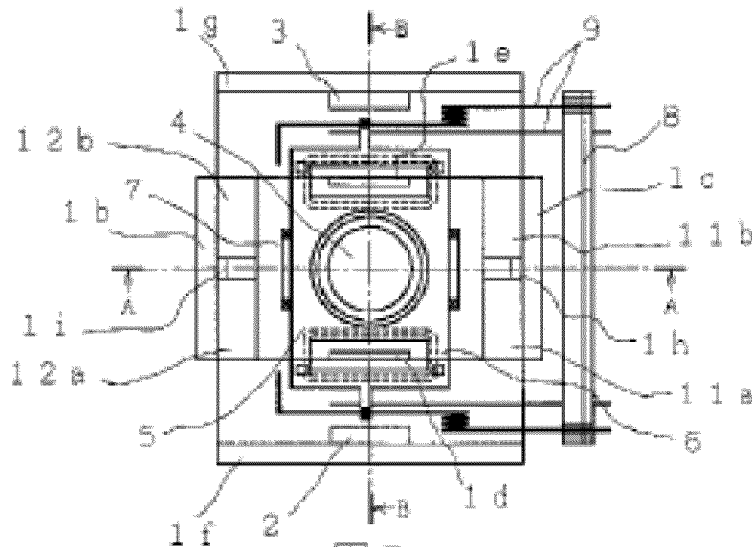
257. As evident from Figure 2 (annotated below) and Sugiyama’s description, tracking coils (7) are positioned vertically on the lens holder 5 (blade), face the magnetic elements 11 and 12, and generate a force to effectuate the tracking operation. Sugiyama, 30-35, 192-193, 201-205, 311, Fig. 2. Thus, Sugiyama teaches or suggests that the tracking coils (7) generate an electromagnetic force in a tracking direction through interaction with the magnetic element (11, 12).



**Figure 2 of Sugiyama
(annotated)**

258. I should note that each of the magnets 11 and 12 has two segments. These are more clearly shown, as segments 11a, 11b, and 12a, 12b, in Sugiyama's Fig. 7 (see below) pertaining to a third embodiment that includes split position arrangement sections 1h and 1i that creates a separation between the two magnet sections. The magnets 11 and 12 in the first and second embodiments (Figs. 1 and 2) of Sugiyama have a similar two-segment configuration because, otherwise, their forces on each of the tracking coils 7 would have cancelled out.

[Fig. 7]



259. In Sugiyama, the first part of magnet 11 (11a in Fig. 7) exerts a force on one leg of the tracking coil 7, while the second part of the magnet 11 (11b in Fig. 7) exerts a similar force and in the same direction on the other leg of coil 7 (whose current is opposite that of the first leg of the same coil), so that the two forces of magnet 11 on the two legs of this tracking coil add up. The same thing happens on the opposite side, where the two sections of magnets 12 (12a and 12b in Fig. 7) act on the two legs of the other tracking coil 7. In this way, a net tracking force (all in the same direction) is produced on both coils 7 in the tracking direction -- which is the radial direction on the optical disk.

4. Claim 4: “The optical pickup actuator according to claim 3, wherein the second coil is positioned on both sides of the blade.”

260. Sugiyama discloses this limitation because its tracking coils (7) are positioned on the sides of the blade, as illustrated in Figures 1 and 2 (annotated above).

5. Claim 10:

a. 10[pre]: “An optical disc drive for a disc that is a recording medium, comprising:”

261. Sugiyama teaches or suggests the preamble because it describes “an objective lens drive apparatus that keeps the relative angle between an objective lens and an optical disc constant at all times, and enables stable writing to and reading from an optical disc.” Sugiyama, Abstract. An optical disc is a recording medium.

b. 10[a]: “a spindle motor for rotating the disc;”

262. Sugiyama teaches or suggests this limitation because it describes an objective lens driving device used for writing information on, and reading information from, an optical disc. Sugiyama, Abstract. A POSITA would have known that optical disc drives included a spindle motor to rotate the disc because this was a basic and commonly known component of an optical disc drive. In addition, a spindle motor in an optical disc drive is AAPA, as it was clearly

described as being part of conventional (prior art) devices in the '055 patent. Ex.

1001, 1:23-27, 3:3-8.

c. 10[b]: “an optical pickup for recording and/or reproducing information by emitting light onto the disc through an objective lens;”

263. Sugiyama teaches or suggests this limitation because it describes an objective lens drive for use in an optical disc device. Sugiyama, Abstract, 64-65. Sugiyama further describes that in its objective lens driving device the light beam can be narrowed down by increasing the NA of the objective lens 4. Sugiyama, 109-112. Additionally, an optical pickup that used emitted light through an objective onto the disc for recording or reproducing information was well-known in the art and was AAPA. Ex. 1001, 1:20-31.

d. 10[c]: “an optical pickup actuator for controlling a position of the objective lens so that the emitted light is focused on a desired position of the disc, the optical pickup actuator comprising:”

264. See element 1[pre], above, where I explained Sugiyama describes an optical pickup actuator that accommodates an objective lens. Sugiyama further rendered this limitation obvious because it described its pickup actuator controlled the position of the objective lens by moving it in tracking, focusing and tilt directions due to the forces generated by the respective coils. Sugiyama, 154-158, 190-200. Sugiyama also described that its “an objective lens that concentrates an

optical beam on an optical disc.” Sugiyama, 148-149; see also, *id.*, 142-145. In addition, all of the limitations in element 10[c] were well-known and typical parts of an optical disc drive, and would have been obvious and known to a POSITA.

e. 10[d]: “a blade holding the objective lens,”

265. See element 1[a], above.

f. 10[e]: “a plurality of suspension wires supporting the blade on a base so that the blade is elastically movable,”

266. See element 1[b], above.

g. 10[f]: “a magnetic element positioned on the base, and,”

267. See element 1[c], above.

h. 10[g]: “a coil positioned horizontally on the blade to generate an electromagnetic force in a focusing direction and/or a tilting direction through interaction with the magnetic element,”

268. See element 1[d], above.

i. 10[h]: “wherein the coil is divided into a plurality of subcoils, where each subcoil is separated from an adjacent subcoil in a vertical direction, and”

269. See element 1[e], above.

j. 10[i]: “wherein the coil comprises a pair of first coils positioned on the blade in a first direction so as to face each other with respect to the objective lens.”

270. See element 1[f], above.

6. **Claim 12: “The optical disc drive according to claim 10, wherein the optical pickup actuator further comprises a second coil positioned vertically on a side of the blade in a second direction substantially perpendicular to the first direction, the second coil generating an electromagnetic force in a tracking direction through interaction with the magnetic element.”**

271. See Claim 3, above.

7. **Claim 13: “The optical disc drive according to claim 12, wherein the second coil is positioned on both sides of the blade.”**

272. See Claim 4, above.

K. Ground 11: Sugiyama alone or in view of AAPA when combined with Kabasawa renders obvious claims 5-6 and 14.

1. **Claims 5/6/14: “... further comprising an inner yoke positioned on the base and positioned within a cavity defined by walls of the first coil, wherein the inner yoke has a pair of first walls disposed opposite the second coil and separated from each other in the second direction.**

273. Claims 5, 6 and 14 are addressed together because they recite similar features but dependent from different base claims: claim 5 depends from claim 3; claims 6 depends from claim 4; and claim 14 depends from claim 12.

274. As I explained in Ground 8, Kabasawa describes an optical pickup apparatus with improved resonance characteristics that includes, among others, an objective lens 4, a focus coil (7a, b), tracking coils (8a-8d), yokes (13,14), and permanent magnets (15) that interact with the coils. Kabasawa, Abstract, Table on p. 3, ¶¶[0043]-[0044], [0049], Fig. 1.

275. Kabasawa inner yoke 14 is positioned inside a cavity defined by focus coil 7a and/or focus coil 7b (first coils). Kabasawa, Table on p. 3, ¶49, Fig. 1 (annotated below). Yoke 14 of Kabasawa has a pair of first walls (highlighted in green) that are opposite the tracking coils (second coil) and are separated from each other in the second direction. *See* Ground 8, Element 17[e].

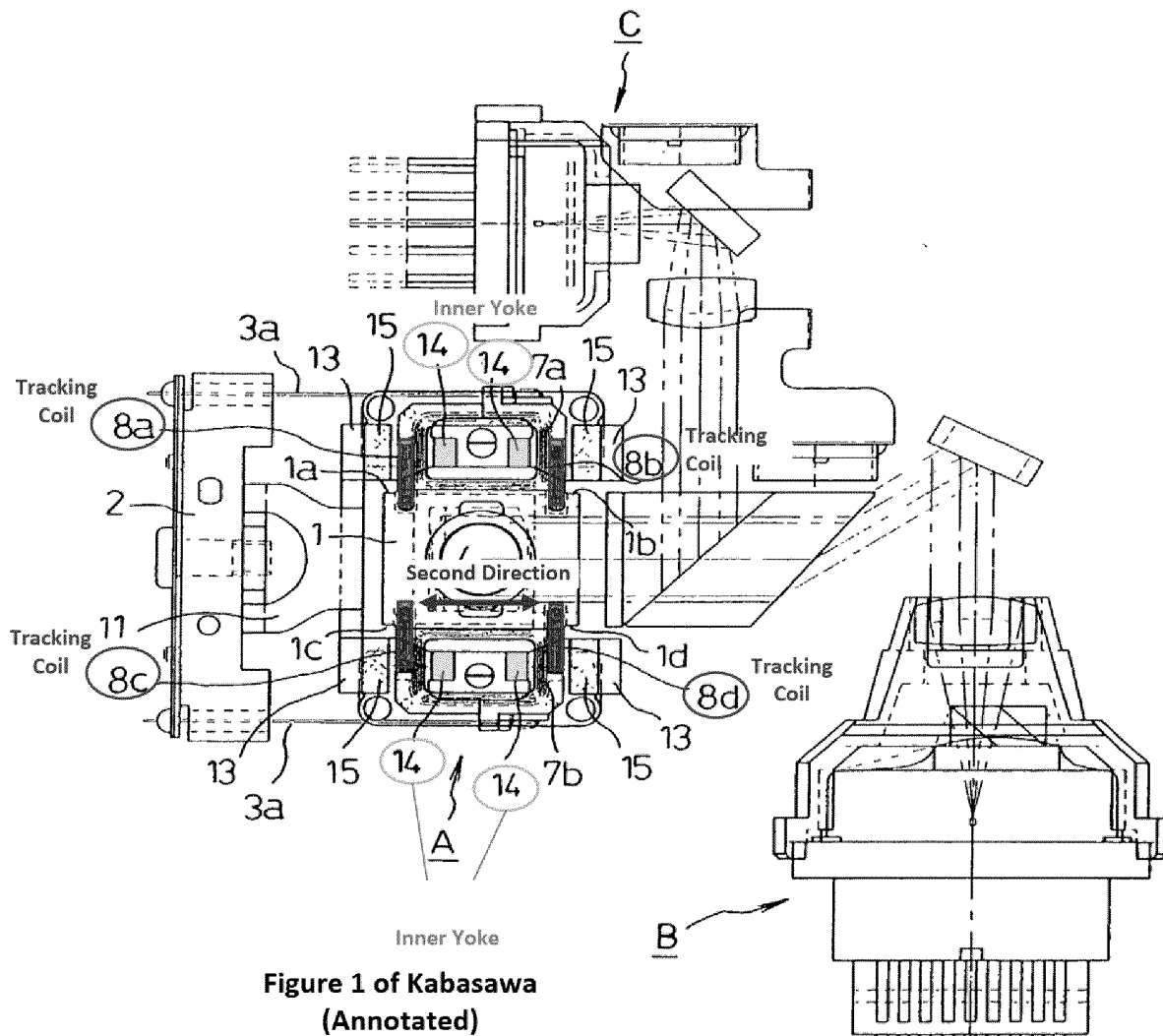
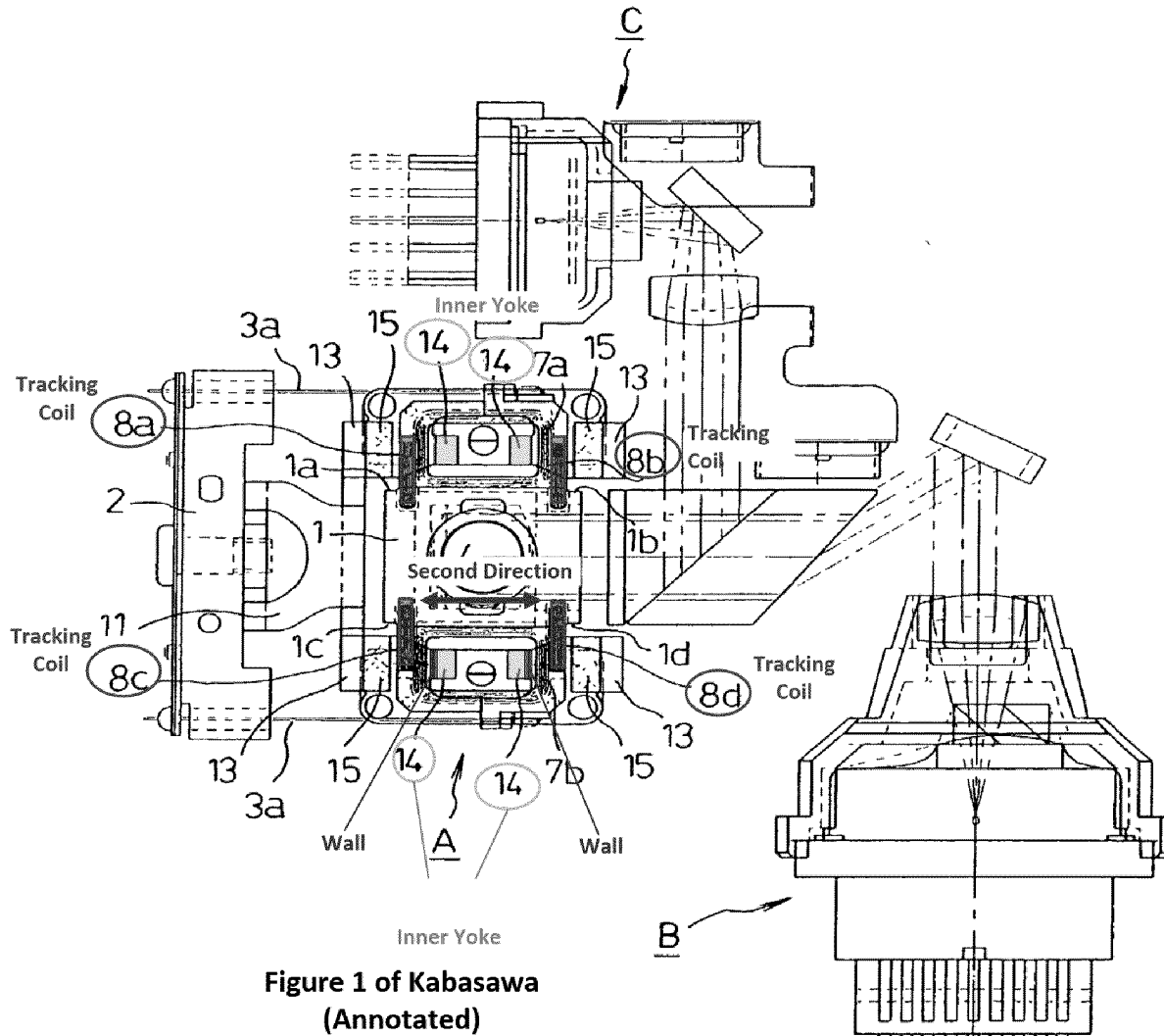


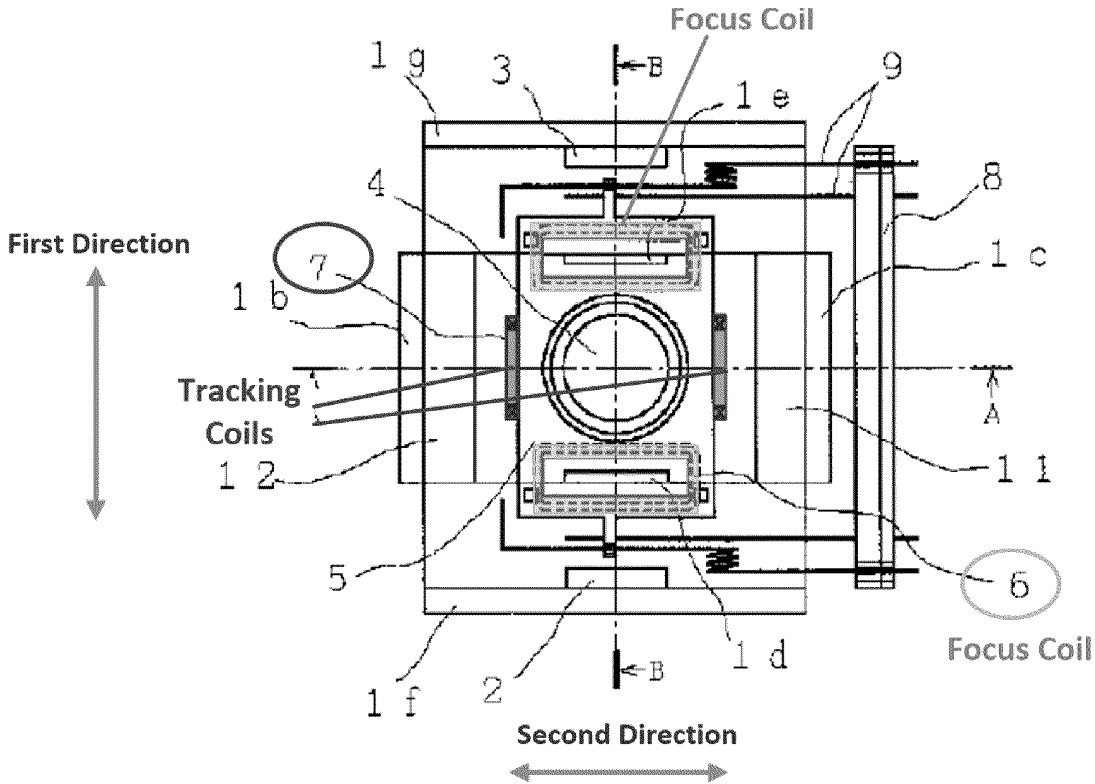
Figure 1 of Kabasawa
(Annotated)

276. As also explained in Ground 8, Element 17[e], yoke 14 of Kabasawa can be alternatively viewed as disclosing the pair of first walls that are separated from each other, as shown in red in the annotated figure below.



277. Turning now to Sugiyama, this reference – as I explained in Ground 10 – renders base claims 3, 4 and 12 obvious, and discloses tracking coils 7 that interact with magnets 11, 12. Sugiyama, ¶28; Fig. 1 (annotated below).

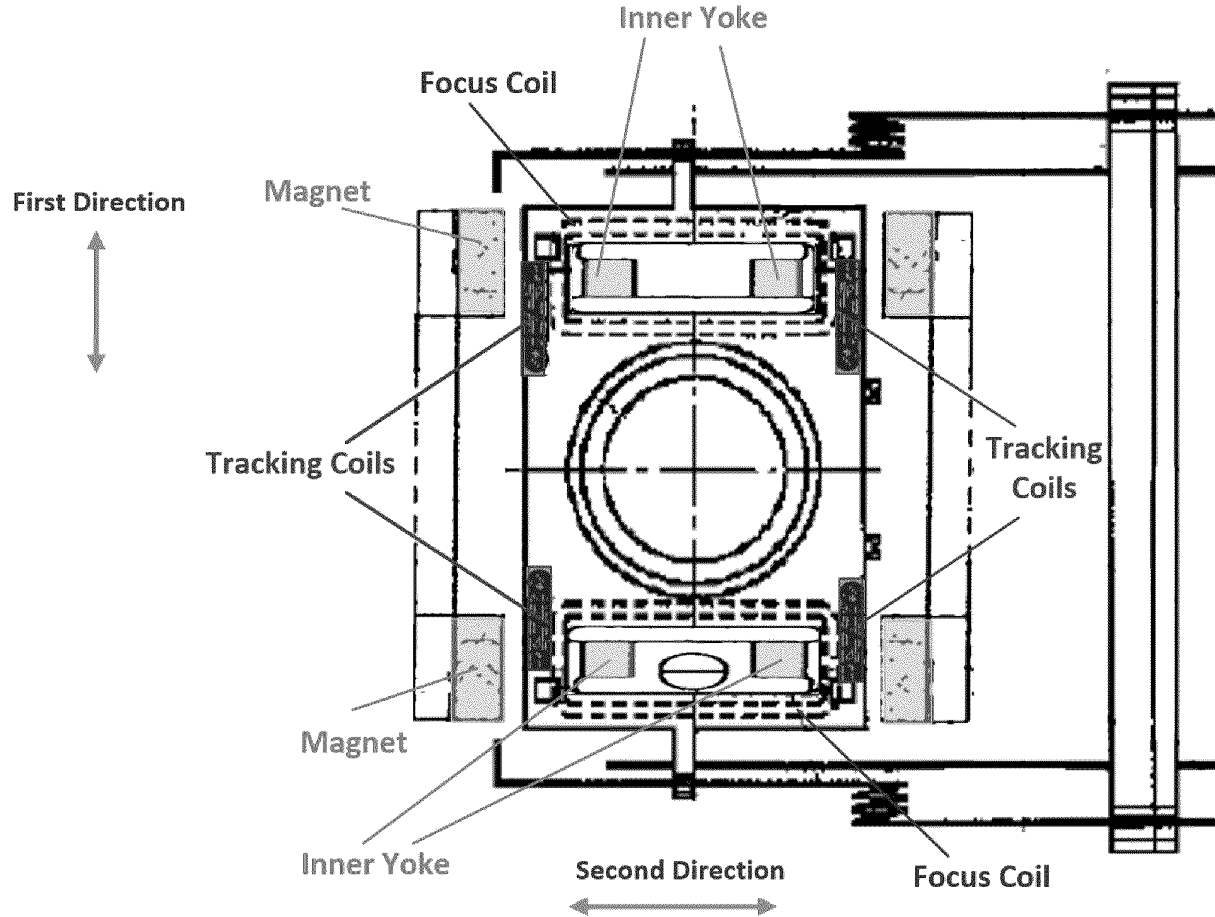
DECLARATION OF MASUD MANSURIPUR, PH.D.
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 7,266,055



**Figure 1 of Sugiyama
(annotated)**

278. In the combination of Sugiyama and Kabasawa, a POSITA would have replaced the pair of tracking coils 7 and the associated magnets 11, 12 of Sugiyama with the four tracking coils 8a-8d and associated magnets 15 of Kabasawa; the combination would also include the inner yoke 14 of Kabasawa, as illustrated in the below rendition.

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**Modification of
Sugiyama with Kabasawa**

279. The inner yoke in the combination would be positioned on the base and within the cavity defined by walls of the first coil (i.e., Sugiyama's focus coil 6), where the inner yoke has a pair of first walls (i.e., the two green yoke components within each focus coil cavity, or two walls of the green component in the alternate mapping). In addition, the pair of first walls are disposed opposite the second coil (tracking coils) and separated from each other in the second direction, as shown in

the above rendering of the combination, as I discussed in connection with claim element 17[e], in Ground 8.

280. A POSITA would have found it obvious and would have been motivated to combine Sugiyama with Kabasawa for several reasons.

281. Sugiyama and Kabasawa provided related teachings about optical pickups in optical disc drives with focus and tracking coils, and therefore a POSITA would have understood that the complementary and related teachings of these references could be combined.

282. Additionally, the use of multiple tracking coils and an inner yoke that improved the magnetic field uniformity was known in the art, and was described in Kabasawa and elsewhere. See, e.g., Kamata in Ground 7. Therefore, a POSITA would have understood that using Kabasawa's four tracking coils and inner yoke configuration was an alternative to what Sugiyama described and would have found it obvious to try to modify Sugiyama based on Kabasawa's teachings.

283. Furthermore, a POSITA would have found it advantageous to include four tracking coils (instead of Sugiyama's two) to provide better and more accurate tracking control. Each of the four tracking coils in the combination could be energized separately to effectuate a more precise and controlled movement of the actuator, with stabilized weight balance and low structural resonance. Kabasawa,

Abstract; ¶53. Therefore, a POSITA would have been motivated to make this combination.

284. Additionally, the combination with Kabasawa would have been beneficial because it would have simplified the design considering that in this combination, magnets 2 and 3 of Sugiyama were not needed. The four magnets (annotated in green in the figure above) exerted forces on both focusing coils 6, both tilt coils 13, and all four tracking coils (the latter annotated in purple in the above figure). By choosing the orientations of the various North and South poles of the four magnets, the desired forces would be exerted on all the coils in this design. This is because the directions of the electric currents in each of the four tracking coils (purple) can be controlled independently of the currents in the focus and tilt coils, and also independently of the directions of currents in the other tracking coils. Selection of the direction of the currents and polarity of the magnets would have all been obvious and known to a POSITA, as I explained earlier.

285. While not needed in rendering the claims obvious, a POSITA would have had an alternate option to retain magnets 2 and 3 in accordance with the original Sugiyama design. In this alternative, the four magnets in the Sugiyama-Kabasawa combination (colored green in the figure above) would each be properly oriented (i.e., either the North or the South pole facing a corresponding coil) so as to ensure that the forces exerted by these magnets do not interfere with the focusing and tilting

operations. Either way, the Sugiyama-Kabasawa combination would have been a good, simple, and improved alternative to Sugiyama alone.

286. Finally, a POSITA would have found it obvious, based on the teachings of Kabasawa, that by providing the four tracking coils that are displaced from the center of the focusing coils and interact with a corresponding inner yoke piece within the cavity of the focusing coil, each tracking coil would experience the effect of the magnetic field only at one of its sides, thereby improving the tracking operation.

287. Additionally, making this combination would have involved making basic mechanical and electrical modifications, which were well within the capabilities of a POSITA. And a POSITA would have undertaken these modifications with a reasonable expectation of success.

VI. CONCLUSION

288. Based on the foregoing analysis, it is my opinion that the challenged claims of the '055 patent are invalid.

DECLARATION OF MASUD MANSURIPUR, PH.D.
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 7,266,055

I hereby declare that all the statements made in this declaration are based on my own true knowledge, that all statements made on information and belief are believed to be true, and that all statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001. I declare under the penalty of perjury under the laws of the United States that all statements made in this declaration are true and correct.

Dated this 27 day of March, 2025 /Masud Mansuripur/

Masud Mansuripur, Ph.D.

Masud Mansuripur

Date of Birth: 1/25/1955
Citizenship: United States

Education

Stanford University	PhD, Electrical Engineering	1981
Stanford University	MS, Mathematics	1980
Stanford University	MS, Electrical Engineering	1978
Arya Mehr University (Iran)	BS, Electrical Engineering	1977

Doctoral Dissertation

Statistics of Noise in Photodetection: Applications in Magneto-optical Recording
Thesis Advisor: Professor Joseph W. Goodman, Stanford University

Employment History

University of Arizona	Chair of Optical Data Storage, 2002-present Professor 1991-present Associate Prof. 1988-91	(College of Optical Sciences)
National Taiwan Univ.	Visiting Chair Professor (Sabbatical, February 1 - July 31, 2010)	(Department of Physics)
Boston University	Associate Prof. 1986-88 Assistant Prof. 1982-86	(Electrical Engineering Dept.)
Stanford University	Post-Doctoral Fellow 1981-82	(Electrical Engineering Dept.)
Xerox Palo Alto Research Center	Consultant 1981-82	
Xerox Research Center of Canada	Member of Research Staff 1980-81	

Departmental/University Committee Memberships

Member/Chair, Admissions Committee, COS, U.A., 1990-95, 2010-11, 2014-16.
Member, Executive Committee, College of Optical Sciences, 1992-93, 2000-01, 2016-18.
Member, Preliminary Examinations Committee, 1999-2000, 2003-04, 2007-08, 2018-19, Chair 2008-11.
Member/Chair, Faculty Search Committee, College of Optical Sciences, 1995-2008, 2010-2012, 2014-15, 2021.
Member/Chair, Promotion & Tenure Committee, U.A. College of Optical Sciences, 1993-94, 1997-99, 2000, 2005-07, 2011, 2013, 2019.
Member/Chair, Scholarships Award Committee, U.A. College of Optical Sciences, 2011-14, 2017-18, 2020-21.
Chair, Curriculum Committee for the Master of Science degree in Photonics Communication Engineering (PCE), U.A., 2010-present.
Member/Chair, MS PCE Admissions Committee, UA College of Optical Sciences, 2011-present.

Member, Committee Reviewing the U.A. Physics Department, April 2011.
Member, Director Search Committee, OSC, U.A., 1991-92.
Chair, Planning Committee, OSC, U.A., 1990.
Member/Chair, Colloquium Committee, U.A. College of Optical Sciences, 1989-90, 2013-14.
Member, Committee on Graduate Studies, Graduate College, U.A., 1989-91.
Member, Promotion and Tenure Committee, College of Eng., Boston University, 1986-88.
Chair, Curriculum Committee, Electrical Engineering Dept., Boston University, 1986-88.

Professional Society/Committee Memberships

Fellow, Optical Society of America (OSA), 2000-present.
Fellow, The International Society for Optics and Photonics (SPIE), 2010-present.
Program Director, *MediaTech Showcase and Conference*, 2006-07.
Contributing Editor, *Optics & Photonics News*, 1996-2006.
Editorial Board Member, *Reports on Progress in Physics*, IOP Publishing, London, 2009-23.
Associate Editor, *Frontiers of Optoelectronics*, a publication of Springer-Verlag, 2013-2016.
Member, Program Committee, SPIE Conference on Optical Trapping and Optical Micro-manipulation, 2009-present.
Member, Program Committee, European Optical Society's Topical Meeting on Diffractive Optics, 2011-12.
Member, International Oversight Committee, Center for Research in Optics and Photonics, Institute of Physics in Sao Carlos, University of Sao Paulo, Brazil, 2011-present.
Topical Editor, *Applied Optics*, 1995-98.
Member, Program Committee, OSA/SPIE/LEOS International Conference on Optical Data Storage, 1988-2001 (co-chair in 1992-94 and in 1997-99); Advisory Committee (2004-2006); Program Committee, 2006-12.
Member, International Advisory Committee, Asia-Pacific Conference on Near-Field Optics (APNFO), 2009-present.
Member, International Advisory Committee, International Symposium on Optical Storage in China (ISOS), 2008-present.
Conference Chair, *Optical Storage and New Storage Technology* (OSNS), held in conjunction with Photonics and Opto-Electronics Meetings (POEM), Wuhan, China, 2009.
Member, International Steering Committee, *Nano-Photonics Down Under 2009* (Sir Mark Oliphant Conferences), Melbourne, Australia, 2009.
Member, Organizing Committee, *Tribute Symposium Honoring Prof. James C. Wyant*, SPIE Annual Meeting, San Diego, California, August 2-3, 2021.
Conference Chair/Organizer, *Symposium Honoring Prof. Joseph W. Goodman*, SPIE Annual Meeting, San Diego, California, August 29, 2007.
Member, Program Committee, Conference on Lasers and Electro-Optics (CLEO), 1990.
Member, Program Committee, Intermag Conference, 1989, 1993.
Member, Working Committee on Optical Data Storage, NSF Workshop on Advanced Data Storage Technology for Computer Systems, Pittsburgh, January 17-18, 1990.
Member, Program Committee, International Symposium on Optical Memory (ISOM), 1991-2005; Advisory Committee, 2005-present.
Member, Program Committee, Magneto-Optical Recording International Symposium (MORIS), 1990-2000 (co-chair in 1992 and 1999).

Cochairman and Organizer, "Second Arizona Workshop on Magneto-Optical Storage Media", Tucson, Arizona, Jan.31-Feb.1, 1991.
Member, Working Group on Optical Data Storage Technology, Workshop on Photonic Materials, National Institute of Standards and Technology, Gaithersburg, Maryland, August 26-27, 1992.
Member, Program Committee, *Asia-Pacific Data Storage Conference*, 1997-2004, International Advisory Committee, 2005-Present.
Member, WTEC panel on the "Future of Data Storage Technologies," sponsored by NIST, DARPA and NSF, April 1998.
Chair, Working group drafting the roadmap on "Hybrid technologies for magnetic and magneto-optical disk data storage," National Storage Industries Consortium (NSIC) workshop, November 1999.
Member, Working group drafting the roadmap on "Phase-change optical disk data storage," National Storage Industries Consortium (NSIC), January 2003.

Honors

Graduated First Rank in Class, Arya-Mehr University of Technology, Tehran, 1977.
Full Scholarship from Arya-Mehr University for Graduate Studies at Stanford.
Full Scholarship from Xerox Corp. for Doctoral and Post-Doctoral Research at Stanford.
IBM Faculty Development Award, Academic Years 1983-84 and 1984-85.
Fellow of OSA (*Optical Society of America*), elected 2000.
Fellow of SPIE (*International Society for Optics and Photonics*), elected 2010.
Teacher of the Year Award, College of Optical Sciences, academic years 2004-5, 2005-6.
Elected Honorary Visiting Professor of Huangzhu University of Science and Technology, Wuhan, China, 2009-2011.
Technical Advisory Board Member, Quinta Co., San Jose, California 1995-2000.
Technical Advisory Board Member, DataPlay Co., Boulder, Colorado, 1998-2002.
Technical Advisory Board Member, Toptica Photonics, Munich, Germany, 1999-2008.
Technical Advisory Board Member, NanoChip Co., San Jose, California, 2003-2008.
Technical Advisory Board Member, Polarizonics Co., Los Angeles, California, 2005-2006.
Technical Advisory Board Member, Atonarp Co., Fremont, California, 2017-Present.
International Advisory Committee Member, Instrument Technology Research Center (National Applied Research Laboratory), Taiwan, 2008-present.
Honorary Advisor of the SPIE Student Chapter, Notre Dame University, Indiana, 2012-present.

Patents and Patent Applications

1. G.A.N. Connell, M. Mansuripur, "Magneto-Optic Media and System Optimization," U.S. Patent 4,466,035, issued August 1984.
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3. M. Mansuripur, "Method and Apparatus for Direct Overwrite on Magneto-optical Recording Media Using Circularly Polarized Microwaves," U.S. Patent 5,200,934, issued April 1993.
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5. K. A. Bates and M. Mansuripur, "Optical devices having array detectors with light receiving photo arrays larger than an incident laser beam cross-section," U.S. Patent 5,566,151, issued October 1996, assigned to IBM Corp., Tucson, Arizona.
6. M. H. Garrett, M. Mansuripur, J. P. Wilde, and P. G. Polynkin, "Reconfigurable Optical Add-Drop Multiplexers Employing Polarization Diversity," U.S. Patent 6,760,511, issued July 6, 2004, assigned to *Capella Photonics, Inc.*, San Jose, California.
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9. B. Bell, I. R. Redmond and M. Mansuripur, "Facial contact lens system for laser diode," serial No. 900722, filed July 6, 2001; assigned to *DataPlay Corporation*, Boulder, Colorado.
10. M. Mansuripur, P. K. Khulbe, J. W. Perry, S. M. Kuebler, J. K. Erwin, "Information storage and retrieval device using macromolecules as storage media," serial No. 600935, filed June 20, 2003; assigned to *Arizona Board of Regents on Behalf of the University of Arizona*.
11. K. Balasubramanian and M. Mansuripur, "Apparatus and method for effective reduction of a laser beam spot size," serial No. 448242, filed May 29, 2003; assigned to *Discovision Associates*.
12. O. Zachar and M. Mansuripur, "Method and system for encoding and detecting optical information," serial No. 189857, filed July 27, 2005; assigned to *Polarizonics, Inc.*, San Jose, California.

Other professional activities

1. Founder and President, *MM Research, Inc.* (www.mmresearch.com), Tucson, Arizona, 1995-present; developing and marketing simulation software for the optics industry.
2. Chief Optical Scientist, *Capella Corp.*, 2001-02 (on 50% leave from University of Arizona).
3. Consultant to Optics industry (Atonarp, Calimetrics, Data General, DataPlay, Digital Equipment Corp., DiscoVision, Energy Conversion Devices, General Electric, Hewlett-Packard, Hitachi, Hitachi-Maxell, IBM, Imation, Intel, Kodak, Komag, Korea Institute of Science & Technology, LG Electronics, Matsushita, MaxOptix, NanoChip, NP Photonics, Oculus, Quinta, Read/Rite, Ricoh, Samsung, Seagate, Sony, TeraStore).

Dissertations by students

1. "Optical instrumentation and characterization for magneto-optical recording media," PhD thesis, Fenglei Zhou, 1992.
2. "Characterization of magneto-optical recording media," PhD thesis, Roger A. Hajjar, 1992.
3. "Characterization of magneto-optical media and systems," PhD thesis, Bruce E. Bernacki, 1992.
4. "Magnetic, magneto-optic, and magneto-transport studies of thin film media of magneto-optical recording," PhD thesis, Te-ho Wu, 1993.
5. "Design and construction of the ultimate ellipsometer, and evaluation of sol-gel derived electro-optic and magneto-optic thin films," PhD thesis, John T. Simpson, 1995.

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7. "Ellipsometric characterization of optical, magneto-optical and magnetic recording media," PhD thesis, Zheng Yan, 1996.
8. "Substrate birefringence and its effects on the performance of optical disk data storage systems," PhD thesis, Timothy D. Goodman, 1996.
9. "Media and systems of optical data storage: investigation of magneto-optical and phase-change recording techniques," PhD thesis, Yung-Chieh Hsieh, 1996.
10. "Characterization of magneto-optical and phase-change media and systems for optical data storage," PhD thesis, Lu Cheng, 1997.
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13. "Measurement of optical phase and polarization in the media and systems of optical data storage," PhD thesis, Rongguang Liang, 2001.
14. "Characteristics of magneto-optical and phase-change media" PhD thesis, Xiaodong Xun, 2001.
15. "Pumping schemes for high concentration Erbium-doped fiber amplifier (EDFA)," MS thesis, Kenji Konno, April 2002.
16. "Studies of dynamic change in reflectivity of thin film metal and phase-change media induced by sub-nanosecond laser pulses," MS thesis, Kazuo Watabe, January 2004.
17. "RBQ: Congestion-adaptive cooperative caching for the World Wide Web," PhD Thesis, Eugenio de la Rosa Rivera, August 2004.
18. "Photonic Crystal Based Optical Devices," PhD Thesis, Tao Liu, August 2005.
19. "Novel Devices for Fiber Laser Application," PhD Thesis, Khanh Kieu, August 2007.
20. "Characterization of Immobilized Aqueous Quantum Dots: Efforts in High-Resolution Microscopy," PhD Thesis, Amber Young, May 2011.
21. "Fabrication of High-Q Ring Resonator and Characterization," MS Thesis, Kazunari Tada, July 2011.
22. "Novel Applications of Semiconductor Nanocrystals," PhD Thesis, Pick-Chung Lau, May 2013.
23. "Emerging Materials for Transparent Conductive Electrodes and their Applications in Photovoltaics," PhD Thesis, Zhaozhao Zhu, May 2017.
24. "Integrating Copper Nanowire Electrodes for Low Temperature Perovskite Photovoltaic Cells," MS Thesis, Trent Mankowski, May (2017).

Publications

a. Books

1. M. Mansuripur, *Introduction to Information Theory*, Prentice-Hall, New Jersey, 1987.
2. M. Mansuripur, *The Physical Principles of Magneto-optical Recording*, Cambridge University Press, United Kingdom, 1995 (paperback 1997).
3. M. Mansuripur, *Classical Optics and its Applications*, Cambridge University Press, U.K., 2002; 2nd expanded edition, 2009; 1st Japanese edition, New Technology Communications, Tokyo, 2006; 2nd expanded Japanese edition, Advanced Communication Media, 2012.
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5. M. Mansuripur, "Mathematical Methods in Science and Engineering: Applications in Optics and Photonics," Cognella Academic Publishing, San Diego, California, 2019.

b. Journal Articles

1. M. Mansuripur, J.W. Goodman, E.G. Rawson, R.J. Norton, "Fiber optics receiver error rate prediction using the Gram-Charlier series," IEEE Trans. Comm. **28**, 402 (1980).
2. M. Mansuripur, "Magnetization reversal in thin magnetic films with perpendicular anisotropy," J. Appl. Phys. **53**, 1660, (1982).
3. M. Mansuripur, G.A.N. Connell, and J.W. Goodman, "Laser-induced local heating of multilayers," Appl. Opt. **21**, 1106, (1982).
4. M. Mansuripur, G.A.N. Connell, and J.W. Goodman, "Signal and noise in magneto-optical readout," J. Appl. Phys. **53**, 4485 (1982).
5. M. Mansuripur and G.A.N. Connell, "Laser induced local heating of moving multilayer media," Appl. Opt. **22**, 666, (1983).
6. M. Mansuripur, "Orientational effect of the extensional flow field on solutions of rigid rod-like macromolecules—disappearance of the isotropic to nematic phase transition," Int. J. Multiphase Flow **9**, 229 (1983).
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c. Review Articles and Book Chapters

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Conference Papers/Presentations

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2. M. Mansuripur, G.A.N. Connell, and D. Treves, "Optimum disk structures and energetics of domain formation in magneto-optical recording" (contributed), presented at the 3rd joint Intermag-Magnetism and Magnetic Materials Conference, July 1982, Montreal, Canada. Published in IEEE Trans. Mag. **18**, 1241 (1982).
3. G.A.N. Connell, R. Allen and M. Mansuripur, "Magneto-optical properties of amorphous terbium-iron alloys" (contributed), presented at the 3rd joint Intermag-Magnetism and Magnetic Materials Conference, July 1982, Montreal, Canada. Published in J. Appl. Phys. **53**, 7759 (1982).
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6. M. Mansuripur, "Thermomagnetic recording and magneto-optic readout in high density erasable optical disk storage systems" (invited), presented at the meeting of the American Physical Society, November 1983, San Francisco, California. Abstract published in Bull. Am. Phys. Soc. **28**, 1315 (1983).
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22. T. W. McDaniel and M. Mansuripur, "Numerical simulation of thermomagnetic writing in RE-TM films" (contributed), presented at the Intermag Conference, Japan. Published in IEEE Trans. Mag. **23**, 2943 (1987).
23. M. Mansuripur, "Special problems in magneto-optics research," (invited), weekly seminar series of Magnetism Technology Center, Carnegie Mellon University, February 1987.
24. M. Mansuripur, "Magneto-optical recording in thin amorphous films of rare earth-transition metal alloys" (invited), presented at the 34th National Vacuum Symposium of the American Vacuum Society, Anaheim, California, November 1987. Summary abstract published in J. Vac. Sci. Technol. A **6**, 1864 (1988).
25. M. Mansuripur, "Optical disk data storage," invited talk at the monthly meeting of the New England Section of the Optical Society of America, Lexington, Massachusetts, September 1987.
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40. M. Mansuripur, "Modeling media and systems of optical data storage," invited talk at the storage research centers faculty meeting at IBM's General Products Division, San Jose, California, December 7-9, 1988.
41. M. Mansuripur, "Analysis of demagnetizing field by the Fourier transform technique," invited talk at the IBM's T.J. Watson Research Laboratory, Yorktown Heights, NY, December 1988.
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43. M. Mansuripur, "Overview of magneto-optical data storage" (invited) workshop on micromagnetics for magnetic recording, Center for Magnetic Recording Research (CMRR), University of California at San Diego, Feb. 8-10, 1989.
44. M. Mansuripur, "Computation of fields and forces in magnetic force microscopy" (contributed paper), presented at the Intermag '89 Conference, Washington, D.C., March 1989.
45. R. Hajjar and M. Mansuripur, "Mean-field analysis of ternary and quaternary rare earth-transition metal alloys for thermomagnetic recording" (contributed), presented at the Intermag '89 Conference, Washington, D.C., March 1989. Published in IEEE Trans. Magnet. **25**, 4021 (1989).

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47. M. Mansuripur and R. Giles, "Magnetization reversal dynamics and the mechanism of coercivity in amorphous RE-TM alloys" (contributed), presented at the International Symposium on Optical Memory (ISOM), Kobe, Japan, September 1989. Extended abstract published in the Proceedings.
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49. M. Mansuripur, "Erasable optical data storage," presented at the Hewlett-Packard Laboratories, Palo Alto, California, November 1989.
50. M. Mansuripur and R. Giles, "Simulation of magnetization reversal dynamics on the Connection Machine" (invited), 34th Annual Conference on Magnetism and Magnetic Materials (MMM), Boston, Massachusetts, November 1989.
51. R. Hajjar, F. Zhou, and M. Mansuripur, "Magneto-optical measurement of anisotropy energy constants on amorphous RE-TM alloys," (contributed), presented at the 34th Annual Conference on Magnetism and Magnetic Materials (MMM), Boston, Massachusetts, November 1989.
52. R. Giles, G. Patterson, A. Bagneres, R. Kotiuga, F. Humphrey and M. Mansuripur, "Micromagnetic simulations on the Connection Machine" (contributed paper), presented at the 4th SIAM Conference on Parallel Processing for Scientific Computing, Chicago, Illinois, December 1989. Published in *Very Large Scale Computation in the 21st Century*, Ed. J.P. Mesirov, Society for Industrial and Applied Mathematics, Philadelphia, 1991.
53. M. Mansuripur, "Computer modeling of magnetization reversal dynamics in magnetic and magneto-optical media", presented at Philips Research Laboratories, Eindhoven, The Netherlands, January 1990.
54. M. Mansuripur, "Progress in modeling of optical data storage media and systems," invited talk at the storage research centers faculty meeting at IBM Laboratories, San Jose, California, January 11-12, 1990.
55. M. Mansuripur, "Computer modeling of optical storage media and systems" invited presentation at the OSA/SPIE/LEOS topical meeting on Optical Data Storage, Vancouver, March 1990.
56. R. Keys, D. Miller, J. W. Goodman, J. Malinson and M. Mansuripur (panelists), "Issues in Optical Technologies: Switching, Logic, and Storage"; evening panel discussion held at the Conference on Lasers and Electro-Optics (CLEO), Anaheim, California, May 1990.
57. B. Bernacki and M. Mansuripur, "Observation of domain wall behavior in the presence of submicrometer defects and substrate structures in the media of magneto-optical recording", (contributed), presented at the Conference on Lasers and Electro-Optics (CLEO), Anaheim, California, May 1990.
58. M. Mansuripur, "Critical issues in optical recording", (invited), Sixth Interdisciplinary Laser Conference, Minneapolis, Minnesota, September 16-19, 1990.
59. M. Mansuripur, "Physics of magneto-optical recording and readout processes," (invited), presented at the Annual Meeting of the Optical Society of America, Joint OSA/LEOS Session on Optical Storage, Boston, Massachusetts, November 1990.

60. M. Mansuripur and R. Giles, "Dynamics of magnetization reversal in amorphous films of RE-TM alloys," (invited), Magneto-Optical Recording International Symposium, Japan (1991).
61. M. Mansuripur, R. Giles and G. Patterson, "Coercivity of domain-wall motion in thin films of amorphous rare earth-transition metal alloys," (contributed), presented at the 35th Annual Conference on Magnetism and Magnetic Materials (MMM), San Diego, California, Oct.29-Nov.1, 1990. Published in J. Appl. Phys. **69**, 4844-4846 (1991).
62. M. Mansuripur, "Computation of electron diffraction patterns in Lorentz electron microscopy of thin magnetic films," (contributed), presented at the 35th Annual Conference on Magnetism and Magnetic Materials (MMM), San Diego, California, Oct.29-Nov.1, 1990.
63. R. Giles and M. Mansuripur, "Micromagnetics of thin film CoX media for longitudinal magnetic recording," (contributed), presented at the 35th Annual Conference on Magnetism and Magnetic Materials (MMM), San Diego, California, Oct.29-Nov.1, 1990. Published in J. Appl. Phys. **69**, 4712-4714 (1991).
64. R. Hajjar, M. Mansuripur, and H.-P. D. Shieh, "Measurements of the anomalous magnetoresistance effect in Co/Pt and Co/Pd multilayer films for magneto-optical data storage applications," (contributed), presented at the 35th Annual Conference on Magnetism and Magnetic Materials (MMM), San Diego, California, Oct.29-Nov.1, 1990. Published in J. Appl. Phys. **69**, 4686-4688 (1991).
65. B.E. Bernacki and M. Mansuripur, "Characterization of magneto-optical recording media in terms of domain boundary jaggedness," (contributed), presented at the 35th Annual Conference on Magnetism and Magnetic Materials (MMM), San Diego, California, Oct.29-Nov.1, 1990.
66. F.L. Zhou, J.K. Erwin, and M. Mansuripur, "Spectral measurements of the magneto-optical Kerr rotation and ellipticity in the media of optical recording," (contributed), presented at the 35th Annual Conference on Magnetism and Magnetic Materials (MMM), San Diego, California, Oct.29-Nov.1, 1990. Published in J. Appl. Phys. **69**, 5091-5093 (1991).
67. M. Mansuripur and R. Giles, "Characterization, modeling and dynamic simulation of the micromagnetic behavior in the media of erasable optical data storage", invited talk at the IBM T.J. Watson Research Center, Yorktown Heights, New York, November 1990.
68. R. Giles, P.R. Kotiuga, M. Mansuripur, "Parallel micromagnetic simulations using Fourier methods on a regular hexagonal lattice", (contributed paper), *4th Biannual IEEE Conference on Electromagnetic Field Computation*, Toronto, Canada, October 1990. Published in IEEE Trans. Magnet. **27**, 3815-3817 (1991).
69. R.A. Hajjar, T. Wu and M. Mansuripur, "Magnetoresistance of Co/Pd and Co/Pt multilayer films for magneto-optical data storage applications," (contributed), presented at the 5th joint MMM-Intermag Conference in Pittsburgh, Pennsylvania, June 1991. Published in J. Appl. Phys. **70**, 6041-6043 (1991).
70. R. Giles and M. Mansuripur, "Simulation of the magnetization reversal dynamics in the process of thermomagnetic recording," (contributed), presented at the 5th joint MMM-Intermag Conference in Pittsburgh, Pennsylvania, June 1991.
71. F.L. Zhou, J.K. Erwin, C.F. Brucker and M. Mansuripur, "Wavelength dependencies of the Kerr rotation angle and ellipticity for the magneto- optical recording media," (contributed), presented at the 5th joint MMM- Intermag Conference in Pittsburgh, Pennsylvania, June 1991. Published in J. Appl. Phys. **70**, 6286-6288 (1991).

72. Hong Fu, M. Mansuripur and P. Meystre, "Generic source of perpendicular anisotropy in amorphous rare earth-transition metal films: Analytical results," (contributed), presented at the 5th joint MMM-Intermag Conference in Pittsburgh, Pennsylvania, June 1991. Published in *J. Appl. Phys.* **70**, 6314-6316 (1991).
73. M. Mansuripur, "Characteristics of magneto-optical recording media", (invited), Optical Recording Department, 3M Company, St. Paul, Minnesota, October 1991.
74. M. Mansuripur, "Characteristics of magneto-optical recording media", invited talk at the Arizona State University Winter Workshop on Microstructure of Magnetic Materials, Wickenburg, Arizona, January 1992.
75. M. Mansuripur, "Characteristics of magneto-optical recording media", invited talk at Center for Magnetic Recording Research (CMRR), University of California, San Diego, January 1992.
76. M. Mansuripur, "Physics of magneto-optical recording: material issues", (invited), *Symposium on Physics and Chemistry of Reversible Optical Recording Media*, Optical Data Storage Meeting, San Jose, California, February 1992.
77. B.E. Bernacki and M. Mansuripur, "Diffraction analysis and evaluation of several focus- and track-error detection schemes for magneto-optical disk systems," (contributed), presented at the ODS topical meeting, February 1992, San Jose, California. Published in *SPIE proceedings* **1663**, 150-156 (1992).
78. H. Sukeda, R.A. Hajjar and M. Mansuripur, "Investigation of magneto- optical recording media using magnetic force microscopy," (contributed), presented at the ODS topical meeting, February 1992, San Jose, California. Published in *SPIE proceedings* **1663**, 190-195 (1992).
79. Hong Fu, M. Mansuripur, G. Patterson and R. Giles, "Investigations of effects of nanostructures on the observable behaviors of thin film magnetic media using large-scale computer simulations," (contributed), presented at the ODS topical meeting, February 1992, San Jose, California.
80. R.A. Hajjar, T. Wu, Hong Fu and M. Mansuripur, "Measurement of the anisotropy energy constants in magneto-optical recording media," (contributed), presented at the ODS topical meeting, February 1992, San Jose, California. Published in *SPIE proceedings* **1663**, 225-231 (1992).
81. A.F. Zhou, J.K. Erwin and M. Mansuripur, "Instrumentation of the variable-angle magneto-optic ellipsometer and its application to MO and other non-magnetic films," (contributed), presented at the ODS topical meeting, February 1992, San Jose, California. Published in *SPIE proceedings* **1663**, 264-286 (1992).
82. M. Mansuripur, "Focusing of polarized light at high NA", (invited), presented at the *Symposium on the Interaction of Focused Electromagnetic Fields with Optical Disk Structures*, Rochester, New York, October 1-2, 1992.
83. M. Mansuripur, "Interaction of focused polarized light with grooved media in magneto-optical disk data storage systems", (contributed), presented at the *Symposium on the Interaction of Focused Electromagnetic Fields with Optical Disk Structures*, Rochester, New York, October 1-2, 1992.
84. M. Mansuripur, "Effects of substrate birefringence in magneto-optical disk data storage systems", (contributed), presented at the *Symposium on the interaction of Focused Electromagnetic Fields with Optical Disk Structures*, Rochester, New York, October 1-2, 1992.

85. Hong Fu and M. Mansuripur, "Coercivity mechanisms in magneto-optical recording media," (contributed), presented at the 37th annual conference on magnetism and magnetic materials (MMM), Houston, Texas, December 1-4, 1992.
86. B.E. Bernacki, T.H. Wu and M. Mansuripur, "Assessment of the local variations in coercivity of magneto-optical recording media using a static tester," (contributed paper), 37th annual conference on magnetism and magnetic materials (MMM), Houston, Texas, December 1-4, 1992, published in *J. Appl. Phys.* **73**, 6838-6840 (1993).
87. T.H. Wu, Hong Fu, T. Suzuki, R.A. Hajjar and M. Mansuripur, "Effect of canting on the measured magnetic anisotropy constant for magneto-optical recording media," (contributed), presented at the 37th annual conference on magnetism and magnetic materials," Houston, Texas, December 1-4, 1992.
88. R. Giles and M. Mansuripur, "Computer simulations of magnetization reversal dynamics," (invited), presented at the Second Magneto-Optical Recording International Symposium (MORIS'92), Tucson, Arizona, December 1992. Published in *Journal of the Magnetism Society of Japan* **17**, Vol. S1, pp.255-257 (1993).
89. Hong Fu, R. Giles and M. Mansuripur, "Coercivity mechanisms in magneto-optical recording media," (invited), presented at the Second Magneto-Optical Recording International Symposium (MORIS'92), Tucson, Arizona, December 1992. Published in *Journal of the Magnetism Society of Japan* **17**, Vol. S1, pp.274-275 (1993).
90. T.H. Wu, B. Bernacki and M. Mansuripur, "Observation of micromagnetic dynamics in magneto-optical recording media," (contributed), presented at the Second Magneto-Optical Recording International Symposium (MORIS'92), Tucson, Arizona, December 1992. Published in *Journal of the Magnetism Society of Japan* **17**, Vol. S1, pp.131-135 (1993).
91. B.E. Bernacki and M. Mansuripur, "The use of Fourier methods to analyze the effects of birefringence in optical disk substrates," (contributed), presented at the meeting of the Optical Society of America, Palm Springs, California, March 1993. Published in *Optical Design for Photonics Technical Digest*, Vol. **9**, 116-119 (1993).
92. Hong Fu, R. Giles and M. Mansuripur, "Micromagnetism in magneto- optical recording media using Connection Machine simulations," (invited), International Magnetism Conference (Intermag), Stockholm, Sweden, April 1993.
93. M. Mansuripur, "Magneto-Optical Recording Technology: Present and Future," keynote address at the symposium on Optical Data Storage Technology, Korea Institute of Science and Technology (KIST), Seoul, Korea, May 1993.
94. M. Mansuripur, "Polarization issues in magneto-optic media and head," (invited), Joint International Symposium on Optical Memory and Optical Data Storage, Maui, Hawaii, July 1993.
95. M. Mansuripur, "Magneto-optical disk data storage," (invited) colloquium at the Center for Solid State Science, Arizona State University, Tempe, Arizona, September 1993.
96. M. Mansuripur, "Substrate birefringence and its consequences for magneto-optical recording", invited talk at the Optical Recording Department, 3M Company, St. Paul, Minnesota, November 1993.
97. M. Mansuripur, "Recent progress in optical data storage research," (invited), Research Laboratories, Eastman Kodak company, Rochester, New York, March 1994.
98. M. Mansuripur and Y-C Hsieh, "A novel method for measuring the vertical birefringence of optical disk substrates," (contributed), presented at the ODS topical meeting, May 1994, San Diego, California.

99. Hong Fu, S. Sugaya, J.K. Erwin, M. Mansuripur, "Characterization of birefringence of optical disk substrates using a novel ellipsometric approach," (contributed), presented at the ODS topical meeting, May 1994, San Diego, California.
100. R.E. Gerber, J.J. Zambuto, J.K. Erwin and M. Mansuripur, "Ring lens focusing and push-pull tracking scheme for optical disk systems," (contributed), presented at the ODS topical meeting, May 1994, San Diego, California.
101. M. Ruane, S. Gadetsky and M. Mansuripur, "Observation of domains and grooves on MO disks with optical microscopy and image processing," (contributed), presented at the ODS topical meeting, May 1994, San Diego, California. Also published in the conference proceedings, SPIE Vol. **2338**.
102. M. Mansuripur, "Advances in Magneto-Optical Recording," keynote address at the symposium on *Optical Data Storage Technology*, Korea Institute of Science and Technology (KIST), Seoul, Korea, May 1994.
103. M. Mansuripur, "Magneto-optical disk data storage," invited tutorial at the third Magneto-Optical Recording International Symposium (MORIS), September 1994, Tokyo, Japan.
104. M. Takahashi, S. Gadetsky and M. Mansuripur, "Study of domain formation mechanism in magneto-optical materials using micro Hall effect measurements," (contributed), presented at the third Magneto-Optical Recording International Symposium (MORIS), September 1994, Tokyo, Japan.
105. S. Gadetsky, T. Suzuki, J.K. Erwin and M. Mansuripur, "Domain wall pinning in amorphous TbFeCo films on patterned substrates," (invited), third Magneto-Optical Recording International Symposium (MORIS), September 1994, Tokyo, Japan.
106. M. Mansuripur, "Advances in erasable optical disk data storage," invited talk at the Hitachi Central Research Laboratory, Tokyo, Japan, September 1994.
107. M. Mansuripur, "Advances in erasable optical disk data storage," invited talk at the NEC Research Laboratories, Tokyo, Japan, September 1994.
108. M. Mansuripur, "Advances in erasable optical disk data storage," invited talk at the Matsushita Electric Company's Research Laboratory, Osaka, Japan, October 1994.
109. M. Mansuripur, "Progress of research in magneto-optical recording," invited talk at the IBM Almaden Research Center, San Jose, California, March 1995.
110. S. Gadetsky, T. Suzuki, J.K. Erwin and M. Mansuripur, "Thermomagnetic recording in amorphous TbFeCo films on patterned substrates," (contributed paper), presented at the Intermag'95 Conference, San Antonio, Texas, April 1995.
111. Hong Fu, Z. Yan and M. Mansuripur, "Dielectric tensor characterization and evaluation of several magneto-optical recording media," (contributed paper), presented at the Optical Data Storage Conference, San Diego, July 1995.
112. R. Gerber and M. Mansuripur, "Dependence of optical disk tracking performance on incident polarization orientation," (contributed paper), presented at the Optical Data Storage Conference, San Diego, July 1995.
113. Lu Cheng, M. Mansuripur and D.G. Howe, "Theoretical investigation of partial response equalization in magneto-optical disk readout," (contributed paper), presented at the Optical Data Storage Conference, San Diego, July 1995.
114. T. Goodman and M. Mansuripur, "Optimization of groove depth for cross-talk cancellation in the scheme of land/groove recording in magneto-optical disk systems," (contributed paper), presented at the Optical Data Storage Conference, San Diego, July 1995.

115. S. Gadetsky, T. Suzuki, J.K. Erwin and M. Mansuripur, "Amorphous TbFeCo films on patterned substrates for high-density thermomagnetic recording," (contributed paper), presented at the Optical Data Storage Conference, San Diego, July 1995.
116. Y.C. Hsieh, M. Takahashi, S. Gadetsky and M. Mansuripur, "Investigation of domain formation mechanism during thermomagnetic recording by micro Hall effect measurements," (contributed paper), presented at the Optical Data Storage Conference, San Diego, July 1995.
117. J. Simpson, G. Teowee and M. Mansuripur, "Optical and magneto-optical characteristics of sol-gel derived bismuth doped iron garnets," (contributed paper), presented at the Optical Data Storage Conference, San Diego, July 1995.
118. T. Suzuki, B. Uryson, J. Hurst, M. Mansuripur, J. Shen and J. Xu, "Blue recording in (BiDy)₃(FeGa)₅O₁₂ garnet multilayer disk," (contributed paper), presented at the Intermag'95 Conference, San Antonio, Texas, April 1995.
119. M. Levenson, M. Mansuripur, M. Tuell and E. Walker, "Birefringence servo for land/groove magneto-optic data storage," presented at the 1995 meeting of the Optical Society of America.
120. M. Mansuripur, "Some of the basic issues in optical disk data storage," keynote address at the *Symposium on Optical Storage Technology*, Korea Institute of Science and Technology (KIST), Seoul, Korea, July 1995.
121. M. Mansuripur, "Some of the basic issues in optical disk data storage," (invited), R & D division, Gold Star Corporation, Seoul, Korea, July 1995.
122. M. Mansuripur, "Some of the basic issues in optical disk data storage," (invited), Samsung Advanced Institute of Technology, Suwon City, Korea, July 1995.
123. M. Mansuripur, "Magneto-optic storage technology," (invited), *Strategic Planning Workshop on Optical Data Storage*, National Institute of Standards and Technology, Gaithersburg, Maryland, July 25, 1995.
124. S. Gadetsky, W.L. Bletscher, and M. Mansuripur, "Barkhausen jumps during domain wall motion in thin magneto-optical films," (contributed paper), 40th Annual Conference on Magnetism and Magnetic Materials (MMM), Philadelphia, Pennsylvania, November 1995.
125. S. Gadetsky, T. Suzuki, J.K. Erwin, and M. Mansuripur, "Magneto-optical recording on patterned substrates," (invited), 40th Annual Conference on Magnetism and Magnetic Materials (MMM), Philadelphia, Pennsylvania, November 1995.
126. Y-C. Hsieh, M. Takahashi, S.N. Gadetsky, and M. Mansuripur, "Dynamic study of domain formation mechanism during thermomagnetic recording by micro Hall effect measurements," (contributed paper), 40th Annual Conference on Magnetism and Magnetic Materials (MMM), Philadelphia, Pennsylvania, November 1995.
127. M. Mansuripur, "Materials for optical storage," (invited), *Research and Education in Optics*, A workshop held by the National Research Council's Committee on Science and Engineering, Beckman Center, Irvine, California, January 4-5, 1996.
128. M. Mansuripur, "Patterned substrates for magneto-optical disk data storage," (invited), weekly colloquium series, department of Physics, Gerhard-Mercator University, Duisburg, Germany, May 1996.
129. M. Mansuripur, "Propagation of the laser beam in optical disk data storage systems," (invited), Conference on Lasers and Electro-Optics (CLEO'96), Anaheim, California, June 1996.

130. M. Mansuripur, "High density MO recording principles," (invited tutorial), fourth Magneto-Optical Recording International Symposium (MORIS), April 1996, Noordwijkerhout, the Netherlands.
131. M. Mansuripur, "Overview of high density MO techniques," (invited), *Workshop on High Density Magneto-optical Techniques*, Philips Research Laboratories, Eindhoven, the Netherlands, May 1996.
132. M. Mansuripur, "Comparison of the ability of phase-change media versus MO media to support high-density blue laser recording," (invited), International Symposium on Optical Memory and Optical Data Storage, Maui, Hawaii, July 8-12, 1996.
133. Y-C. Hsieh, M. Mansuripur, and J. Volkmer, "Measurement of the thermal coefficients of phase-change optical recording films," (contributed), International Symposium on Optical Memory and Optical Data Storage, Maui, Hawaii, July 8-12, 1996.
134. M. Mansuripur, "Progress in optical data storage research," (invited), Eastman Kodak Company, Research Laboratories, January 1997.
135. Y-C. Hsieh and M. Mansuripur, "Image contrast in polarization microscopy of magneto-optical media through plastic substrates," (contributed), presented at the Optical Data Storage Conference, Tucson, Arizona, April 1997.
136. Lu Cheng and M. Mansuripur, "Measurement of the thermal coefficients of erasable phase-change media," (contributed), presented at the Optical Data Storage Conference, Tucson, Arizona, April 1997.
137. M. Mansuripur, J.K. Erwin, W. Bletscher, S.G. Kim, S.K. Lee, Chubing Peng, R.E. Gerber, K. Bates, C. Bartlett, T.D. Goodman, L. Cheng, Chong sam Chung, and Taekyung Kim, "A versatile polychromatic dynamic testbed for testing of optical disks," (contributed), presented at the Optical Data Storage Conference, Tucson, Arizona, April 1997.
138. Chubing Peng and M. Mansuripur, "Edge detection in phase-change optical data storage," (contributed), presented at the Optical Data Storage Conference, Tucson, Arizona, April 1997.
139. Chubing Peng and M. Mansuripur, "Sources of noise in optical disk data storage," (contributed), presented at the Optical Data Storage Conference, Tucson, Arizona, April 1997.
140. C. Bartlett, D. Kay, and M. Mansuripur, "Computer simulations of the effects of disk tilt and lens tilt on the push-pull tracking error signal in an optical disk drive," (contributed), presented at the Optical Data Storage Conference, Tucson, Arizona, April 1997.
141. J.H. Yoo, C.W. Lee, D.H. Shin, C. Bartlett, K.I. Cheong, J.K. Erwin, and M. Mansuripur, "Investigation of certain diffraction effects in a double-layer optical disk," (contributed), presented at the Optical Data Storage Conference, Tucson, Arizona, April 1997.
142. M. Mansuripur, "Recent research on optical data storage technology," (invited) keynote address at the *5th Symposium on Optical Data Storage Technology*, Korea Institute of Science and Technology (KIST), Seoul, Korea, July 1997.
143. M. Mansuripur, "Progress in optical disk data storage research," (invited), Samsung Electronics, Suwon City, Korea, July 1997.
144. M. Mansuripur, "A comparison of noise in magneto-optical and phase-change recording," (invited), *Asia-Pacific Data Storage Conference '97*, Ta-shee resort, Taiwan, July 1997.
145. M. Mansuripur, "Status and prospects of optical disk technology," (invited), Denso Corporation, Nagoya, Japan, July 1997.

146. M. Mansuripur, "Measurement and simulations of the recording process in phase-change optical recording media," (invited), Toyota Institute of Technology, Nagoya, Japan, July 1997.
147. M. Mansuripur, "Signal and noise in optical disk data storage," (invited) Quinta Corporation, San Jose, California, August 1997.
148. M. Mansuripur, "Current status and prospects of optical disk technology," (invited), Komag Corporation, San Jose, California, August 1997.
149. M. Mansuripur, "Progress in optical disk data storage research," (invited) TeraStor Corporation, San Jose, California, August 1997.
150. M. Mansuripur, "Measurements and simulations of the recording process in phase-change optical recording media," (invited), Energy Conversion Devices Co., Troy, Michigan, September 1997.
151. M. Mansuripur, "Overview of optical disk data storage," (invited) Data Storage Institute, University of Singapore, November 1997.
152. Wei-Hung Yeh, Lifeng Li and M. Mansuripur, "Vector diffraction and surface-wave excitation in an optical disk system," (contributed), presented at the *1998 Optical Data Storage Conference*, Aspen, Colorado, May 1998.
153. R. Narayan M. Mansuripur, "Measurement of crystallization speed in phase-change media," (contributed), presented at the *1998 Optical Data Storage Conference*, Aspen, Colorado, May 1998.
154. Chubing Peng and M. Mansuripur, "Exchange coupling in magneto-optical CAD-MSR disks," (contributed), presented at the *1998 Optical Data Storage Conference*, Aspen, Colorado, May 1998.
155. Chubing Peng and M. Mansuripur, "Edge detection readout signal and cross-talk in phase-change optical data storage," (contributed), presented at the *1998 Optical Data Storage Conference*, Aspen, Colorado, May 1998.
156. M. Mansuripur, "Micromagnetics of CAD-MSR media for erasable optical data storage," (invited) Quinta Corporation, San Jose, California, January 1998.
157. M. Mansuripur, "Principles of optical disk data storage," (invited) General Electric Corporate Research and Development Center, Schenectady, New York, March 1998.
158. M. Mansuripur, "Advances in optical disk data storage," (invited), Hitachi Central Research Laboratory, Tokyo, Japan, April 1998.
159. M. Mansuripur, "Progress in Optical Data Storage Research," (invited), Read-Rite Corporation, San Jose, California, May 1998.
160. M. Mansuripur, "Current issues in rewritable optical disk data storage," (invited), seventh biennial IEEE international nonvolatile memory technology conference, Albuquerque, New Mexico, June 1998.
161. M. Mansuripur, "Status and prospects of optical data storage," (invited), Rohm & Haas Chemical Co., Philadelphia, PA, September 1998.
162. M. Mansuripur, "Evanescent coupling in SIL-based optical data storage systems," (contributed), *Second Arizona Workshop on Near Field Recording*, Tucson, Arizona, October 1998.
163. M. Mansuripur, "Magneto-optics: Science and Technology," (invited), 45th International Symposium of the American Vacuum Society, Baltimore, Maryland, November 1998.
164. M. Mansuripur, "Progress in Optical Data Storage Research," (invited), Hewlett-Packard Laboratories, Palo Alto, California, November 1998.

165. M. Mansuripur, "Progress in Optical Data Storage Research," (invited), Quinta Corporation, San Jose, California, November 1998.
166. M. Mansuripur, "Evanescent coupling in SIL-based optical disk systems," (invited), Sony Research Laboratories, Tokyo, Japan, November 1998.
167. M. Mansuripur, "Role of substrate in optical disk data storage," (invited), Hoya Glass Company, Tokyo, Japan, November 1998.
168. M. Mansuripur, "Experimental and theoretical investigations of amorphization and crystallization in phase-change media," (keynote address), 10th annual symposium on phase-change optical recording, Mishima City, Japan, November 1998.
169. M. Mansuripur, "Advances in phase-change optical disk data storage," (invited), Matsushita Electric Company's Research Laboratories, Osaka, Japan, November 1998.
170. M. Mansuripur, "Progress in phase-change optical disk data storage," (invited), Calimetrix Corporation, Oakland, California, December 1998.
171. M. Mansuripur, "Physical background for near-field recording," (invited), Tutorial Session at the Magneto-Optical Recording International Symposium (MORIS'99), Monterey, California, January 1999.
172. M. Mansuripur, "Recent advances in optical data storage," (plenary presentation), SPIE's Photonics West Conference, San Jose, California, January 1999.
173. M. Mansuripur, "Thermal aspects of hybrid magneto-optical recording," (invited), Quinta Corporation, San Jose, California (June 1999).
174. P. Khulbe, X. Xun, and M. Mansuripur, "Crystallization and amorphization studies on a Ge₂Sb₂Te₅ thin film sample using a two-laser static tester," (contributed), presented at the International Symposium on Optical Memory and Optical Data Storage, Kauai, Hawaii (July 1999).
175. C. Peng and M. Mansuripur, "Studies of the crystallization process in thin films of GeSbTe," (contributed), presented at the International Symposium on Optical Memory and Optical Data Storage, Kauai, Hawaii (July 1999).
176. W. H. Yeh, Lifeng Li, and M. Mansuripur, "Computation of the effective depth of grooves in an optical disk using vector diffraction theory," (contributed), presented at the International Symposium on Optical Memory and Optical Data Storage, Kauai, Hawaii (July 1999).
177. W. H. Yeh and M. Mansuripur, "Evanescent coupling in magneto-optical and phase-change disk systems based on the solid immersion lens," (contributed), presented at the International Symposium on Optical Memory and Optical Data Storage, Kauai, Hawaii (July 1999).
178. B. Wolfring, T. Weber, T. Mueller-Wirts, and M. Mansuripur, "VERSATEST-I, a versatile polychromatic dynamic testbed for optical disks," (contributed), presented at the SPIE's 44th annual meeting, The International Symposium on Optical Science, Engineering, and Instrumentation," Denver, Colorado, July 1999.
179. M. Mansuripur, C. Peng, and P. Khulbe, "Characterization of the recording process on phase-change and magneto-optical media," (invited), presented at the SPIE's 44th annual meeting, The International Symposium on Optical Science, Engineering, and Instrumentation," Denver, Colorado, July 1999.
180. M. Mansuripur, "Progress in optical data storage research," (invited) SIROS Technologies, Inc., San Jose, California, August 1999.

181. M. Mansuripur, "Tools and instruments in optical data storage research," (invited) TuiOptics, Inc., Munich, Germany, December 1999.
182. X. Xun, C. Peng and M. Mansuripur, "Estimation of thermal conductivity of magneto-optical media," (contributed) presented at the *Optical Data Storage Conference*, Vancouver, Canada, May 2000.
183. C. Peng and M. Mansuripur, "Theoretical investigation of thermal cross-track cross-talk in high density DVD-RAM system," (contributed) presented at the *Optical Data Storage Conference*, Vancouver, Canada, May 2000.
184. C. Peng and M. Mansuripur, "Various sources of noise in optical data storage systems," (contributed) presented at the *Optical Data Storage Conference*, Vancouver, Canada, May 2000.
185. K. Saito, N. Miyagawa, and M. Mansuripur, "Optical disk noise analysis using rigorous vector diffraction calculations," (contributed), presented at the *Optical Data Storage Conference*, Vancouver, Canada, May 2000. Also published in *SPIE Proceedings*, Vol. **4090**, 74-81 (2000).
186. R. Liang, Lifeng Li and M. Mansuripur, "Polarization dependence of the Kerr magneto-optical signal from periodic one-dimensional arrays of magnetic domains," (contributed) presented at the *Optical Data Storage Conference*, Vancouver, Canada, May 2000.
187. E. M. Wright, P. K. Khulbe, T. Hurst and M. Mansuripur, "Simulation of phase transformations in phase-change media," (contributed) presented at the *Optical Data Storage Conference*, Vancouver, Canada, May 2000.
188. M. Mansuripur, "Studies of phase-change media for rewritable optical data storage," (invited), *Hewlett-Packard Research Laboratories*, Palo Alto, California, June 2000.
189. M. Mansuripur, "Signal and noise in magneto-optical disk readout" (invited) presented at the IEEE Communications Society's *Data Storage Signal Processing Workshop*, New Orleans, June 2000.
190. M. Mansuripur, "Phase-change Media of Optical Data Storage," (invited), *Naval Research Laboratories*, Washington, DC, July 2000.
191. M. Mansuripur, "Rewritable Optical Disk Technologies," (invited) presented at the *Future of Computing Symposium*, SPIE, August 2000.
192. M. Mansuripur, "Understanding Classical Optics through Computer Simulations," (invited) *Canon Research Center*, Tokyo, Japan, October 2000.
193. M. Mansuripur, "Rewritable Optical Disk Technologies," (invited), *Toyota Institute of Technology*, Nagoya, Japan, October 2000.
194. M. Mansuripur, "Noise and its consequences in optical data storage," (invited tutorial), Joint MORIS/APDSC conference, Nagoya, Japan, October 2000.
195. M. Mansuripur, "Real-time studies of mark formation processes in phase-change and magneto-optical media using a two-laser static tester," (invited) presented at the Joint MORIS/APDSC conference, Nagoya, Japan, October 2000.
196. N. Miyagawa and M. Mansuripur, "Segmented analog recording on phase-change disk," (contributed), presented at the Joint MORIS/APDSC conference, Nagoya, Japan, October 2000. Published in the Technical Digest of the conference, pp174-175.
197. M. Mansuripur, "Future of Optical Disk Data Storage," (keynote address), *Korea Institute of Science and Technology*, Seoul, Korea, November 2000.
198. M. Mansuripur, "Understanding Classical Optics using Computer Simulations," (invited), *Apollo Photonics, Inc.*, Toronto, Canada, December 2000.

199. M. Mansuripur, "DNA, Human Memory, and the Storage Technology of the 21st Century," (keynote address), *Optical Data Storage Conference*, Santa Fe, April 2001.
200. P. K. Khulbe, T. Hurst, and M. Mansuripur, "Temperature-dependence of optical constants in phase-change media," (contributed), *Optical Data Storage Conference*, Santa Fe, April 2001, also published in the *Proceedings of SPIE*, Vol. **4342**, pp 103-107 (2001).
201. G. M. Fischer, B. Medower, R. Revay and M. Mansuripur, "Thermal Properties and Crystallization Dynamics of a Phase-change Alloy for Write-Once Optical Storage," (contributed), *Optical Data Storage Conference*, Santa Fe, April 2001.
202. X. Xun, C. Peng, and M. Mansuripur, "Scattering Measurements on Optical Disks", (contributed), *Optical Data Storage Conference*, Santa Fe, April 2001.
203. C. Peng and M. Mansuripur, "Measurement of the thermal coefficients of erasable phase-change optical recording media", (contributed), *Optical Data Storage Conference*, Santa Fe, April 2001.
204. R. Liang, C. Peng, K. Nagata, K. Daly-Flynn, and M. Mansuripur, "Optical characterization of multilayer stacks for phase-change media", (contributed), *Optical Data Storage Conference*, Santa Fe, April 2001, also published in the *Proceedings of SPIE*, Vol. **4342**, pp 134-145 (2001).
205. M. Mansuripur, "Characterization of phase-change media of optical recording," (invited), weekly seminar series of the Data Storage Systems Center, Carnegie Mellon University, Pittsburgh, February 2001.
206. M. Mansuripur, "Optical System Simulations with DIFFRACT," (invited), *SPIE Symposium on Wave-optical Systems Engineering*, San Diego, California, July 2001.
207. N. Miyagawa and M. Mansuripur, "Advanced grey scale recording on phase-change optical disks," (invited), *International Symposium on Optical Memory (ISOM)*, Taipei, Taiwan, October 2001. Published in the Technical Digest of the conference, pp 240-241.
208. M. Mansuripur, "Dependence of capacity on media noise in data storage systems," (invited), *International Symposium on Optical Memory (ISOM)*, Taipei, Taiwan, October 2001.
209. M. Mansuripur, "DNA, Human Memory, and the Storage Technology of the 21st Century," *Weekly Colloquium Series, Optical Sciences Center, University of Arizona*, February 2002.
210. M. Mansuripur, "Optical, thermal, and materials aspects of short laser pulses for optical data storage," (invited), presented at the Joint ISOM/ODS conference in Hawaii, July 2002.
211. M. Mansuripur, "Optical, thermal, and materials aspects of short laser pulses for optical data storage," (invited), Advisory Board Meeting, *Toptica Corporation*, Munich, Germany, August 2002.
212. M. Mansuripur, "DNA, Human Memory, and the Storage Technology of the 21st Century," (invited), *Future Information Strategy Meeting of the Academic Frontier Center*, Nagoya, Japan, October 2002.
213. M. Mansuripur, "Optical, thermal, and materials aspects of short laser pulses for optical data storage," (invited), *Toyota Institute of Technology*, October 2002.
214. M. Mansuripur, "DNA, Human Memory, and the Storage Technology of the 21st Century," (invited), *Hitachi-Maxell Corporation*, Tsukuba, Japan, October 2002.
215. M. Mansuripur, "Principles of Optical Disk," (invited) *Sixth International Workshop on Laser Physics and Applications*, Tunis, Tunisia, December 2002.
216. M. Mansuripur, "Biological Data Storage," (invited) *Sixth International Workshop on Laser Physics and Applications*, Tunis, Tunisia, December 2002.

217. M. Mansuripur, "How CD- and DVD-players work," (invited) *Photonics Initiative Workshop*, Tucson, Arizona, January 2003.
218. M. Mansuripur, "How CD- and DVD-players work," *Graduate Colloquium*, Department of Mechanical Engineering, University of Arizona, Tucson (February 2003).
219. M. Mansuripur, "Information storage and retrieval using macromolecules as storage media," (invited) Teleseminar at the *NSF/SRC Engineering Research Center for Environmentally Benign Semiconductor Manufacturing*, University of Arizona, Tucson (March 2003).
220. M. Mansuripur, "How CD- and DVD-players work," *Freshman Colloquium Series*, College of Engineering and Mines, University of Arizona, Tucson, (April 2003).
221. M. Mansuripur, P. K. Khulbe, S. M. Kuebler, J. W. Perry, M. S. Giridhar, and N. Peyghambarian, "Information Storage and Retrieval using Macromolecules as Storage Media," (contributed), *Optical Data Storage Conference*, Vancouver, Canada, May 2003.
222. A. R. Zakharian, J. V. Moloney, and M. Mansuripur, "Interaction of Light with Sub-wavelength Structures in Optical Storage Media," (contributed), *Optical Data Storage Conference*, Vancouver, Canada, May 2003.
223. M. Mansuripur, "How CD- and DVD-players work," (invited) *Science and Technology Center*, University of Washington, Seattle (June 2003).
224. M. Mansuripur, A. Euteneuer, D. Fernandez, and B. Medower, "Media Characterization Methods for Optical Data Storage," (invited), presented at the *CLEO_Europe*, Munich, Germany (June 2003).
225. M. Mansuripur, P. K. Khulbe, C. Peng, and A. Euteneuer, "Characterization of phase-change and magneto-optical media of optical recording," (invited), *Hewlett-Packard Laboratories*, Corvallis, Oregon (September 2003).
226. M. Mansuripur, P. K. Khulbe, S. M. Kuebler, J. W. Perry, M. S. Giridhar, and N. Peyghambarian, "Information storage and retrieval using macromolecules as storage media," (invited) *Philips Research Laboratories*, Eindhoven, Netherlands (Sept. 2003).
227. M. Mansuripur, A. R. Zakharian, and J. V. Moloney, "Interaction of light with subwavelength structures in optical storage media," (invited), *4th Asia-Pacific Conference on Near Field Optics (AP-NFO4)*, Taipei, Taiwan (October 2003).
228. M. Mansuripur, "Macromolecular Data Storage," *Chemical and Biochemical Sensors Workshop*, Tucson, Arizona (November 2003).
229. J. V. Moloney, D. Kouznetsov, A. Mafi, A. Schülzgen, M. Mansuripur, M. Fallahi, and N. Peyghambarian, "Novel Designs for Double-Clad and Photonic Crystal Highly-Doped Fiber Amplifiers and Lasers," *SSDLTR 2003 Technical Digest*, Fiber-4 (2003).
230. M. Mansuripur, K. Watabe, P. Polynkin, C. Peng, J. K. Erwin, and W. Bletscher, "Optical and thermal aspects of phase-change media of optical data storage," (invited) annual meeting of *Materials Research Society*, Boston, Massachusetts (December 2003).
231. M. Mansuripur, P. Khulbe, C. Peng, and A. Euteneuer "Optical and thermal aspects of phase-change media of optical data storage," (invited tutorial) annual meeting of the *Materials Research Society*, Boston, Massachusetts (December 2003).
232. M. Mansuripur and P. Khulbe, "Macromolecular data storage," (invited), *DIMACS Workshop on Theoretical Advances in Information Recording*, Rutgers University, Piscataway, New Jersey (March 2004).

233. M. Mansuripur and P. Khulbe, "Macromolecular data storage with petabyte/cm³ density, highly parallel read/write operations, and genuine 3D storage capability," (invited), *Optical Data Storage Conference*, Monterey, California (April 2004).
234. M. Mansuripur, A. Zakharian, and J. Moloney, "Transmission of light through small elliptical apertures," (contributed) *Optical Data Storage Conference*, Monterey, California (April 2004).
235. T. Liu, A. Zakharian, R. Rathnakumar, M. Fallahi, J. V. Moloney, and M. Mansuripur, "Applications of photonic crystals in optical data storage," (contributed) *Optical Data Storage Conference*, Monterey, California (April 2004).
236. K. Watabe, P. Polynkin, and M. Mansuripur, "Behavior of GeSbTeBi phase-change optical recording media under sub-nanosecond pulsed laser irradiation," (contributed) *Optical Data Storage Conference*, Monterey, California (April 2004).
237. M. Mansuripur, A. R. Zakharian, Y. Xie, and J. V. Moloney, "Transmission of light through subwavelength apertures," (Invited) *ETOS Workshop*, Cork, Ireland, July 2004.
238. M. Mansuripur, "Relevant Technologies for Future Generations of Optical Data Storage," (Invited) *MediaTech Conference*, Hollywood, California, August 2004.
239. M. Mansuripur, A. R. Zakharian, Y. Xie, and J. V. Moloney, "Light transmission through subwavelength slits and apertures," (Invited) *4th Asia Pacific Data Storage Conference*, Taiwan, September 2004.
240. N. Peyghambarian, A. Schulzgen, T. Qiu, L. Li, V. Temyanko, P. Polynkin, M. Mansuripur, A. Mafi, and J. V. Moloney, "Recent advances towards 1W/cm single-mode fiber lasers," (Invited) *LEOS 2004*, Puerto Rico, November 2004.
241. M. Mansuripur, A. R. Zakharian, J. V. Moloney, "Radiation pressure and the linear momentum of the electromagnetic field," *Weekly Colloquium Series, Optical Sciences Center, University of Arizona*, October 2004.
242. M. Mansuripur, A. R. Zakharian, and J. V. Moloney, "Radiation pressure and the linear momentum of the electromagnetic field," (Invited), *Spring School: Nonlinear and Multiscale Photonics*, Tucson, Arizona, April 2005.
243. M. Mansuripur, "Radiation pressure and the linear momentum of the electromagnetic field," (Invited), *European Optical Society Topical Meeting on Advanced Optical Imaging*, Imperial College, London, UK, July 2005.
244. M. Mansuripur, Y. Xie, A. R. Zakharian, and J. V. Moloney, "Transmission of light through slit apertures in metallic films," (contributed) *Optical Data Storage Conference*, Hawaii, July 2005.
245. M. Mansuripur, A. R. Zakharian, and J. V. Moloney, "Radiation pressure and the distribution of electromagnetic force in dielectric media," (Invited), *SPIE Conference on Optical Trapping & Micro-manipulation*, San Diego, California, August 2005.
246. A. Kosterin, V. Temyanko, M. Fallahi, and M. Mansuripur, "Tapered fiber bundles for high power applications," *Optical Fiber Communication Conference*, 2005.
247. M. Mansuripur, "How CD and DVD Players Work," (Invited) *Society of Industrial and Applied Mathematics (Student Chapter)*, Tucson, Arizona, August 2005.
248. M. Mansuripur and P. K. Khulbe, "DNA, human memory, and the storage technology of the 21st century," (Keynote address) *ASME-Integrated Nanosystem Conference*, Berkeley, California, September 2005.

249. M. Mansuripur, "Phase-change technology for advanced optical data storage," (Keynote address), *4th European Symposium on Phase Change and Ovonic Science (E*PCOS 05)*, King's College, Cambridge University, UK, September 2005.
250. M. Mansuripur, "Radiation pressure and the linear momentum of the electromagnetic field," (Invited) *Department of Physics, University of Glasgow*, UK, September 2005.
251. M. Mansuripur, "Radiation pressure and the linear momentum of light," (contributed) *Annual meeting of the Optical Society of America*, Tucson, Arizona, October 2005.
252. M. Mansuripur, "Investigations of light's momentum and radiation pressure with application to near-field and far field optical trapping and optical binding," (Invited) *Asia Pacific Near Field Optics (APNFO-05)*, Niigata, Japan, November 2005.
253. M. Mansuripur, "Principles and Techniques of Macromolecular Data Storage," (Invited), *Toyota Institute of Technology*, Nagoya, Japan, November 2005.
254. M. Mansuripur, K. Kieu, and K. Narumi, "Sub-nanosecond pulsed laser studies of phase-change recording media," (Invited) *Optical Data Storage Conference*, Montreal, Canada, April 2006. Manuscript published in *SPIE Proceedings* **6282**, "Investigation of crystallization and amorphization dynamics of phase-change thin films using sub-nanosecond laser pulses."
255. Y. Xie, A. R. Zakharian, J.V. Moloney, M. Mansuripur, "Bloch mode coupling to analyze periodic slits in metallic films," (contributed) *OSA Topical Meeting "Integrated Photonics Research and Applications: Nanophotonics"*, Uncasville, Connecticut, April 2006.
256. M. Mansuripur, A. R. Zakharian, and J. V. Moloney, "Single-beam trapping of micro-beads in polarized light," (contributed), *SPIE Symposium on Optical Trapping and Optical Micro-manipulation*, August 2006. Manuscript published in *SPIE Proceedings* **6326**, "Equivalence of total force (and torque) for two formulations of the Lorentz law."
257. P. Polynkin, A. Polynkin, D. Panasencko, M. Mansuripur, J. Moloney, N. Peyghambarian, "Picosecond fiber laser oscillator at 1.5 μ m with 2.3W average power and 160 MHz repetition rate," (contributed) *Photonics West*, San Jose, CA (January 2006).
258. D. Panasencko, P. Polynkin, A. Polynkin, J. Moloney, M. Mansuripur, N. Peyghambarian, "High average power harmonically mode-locked femtosecond ring laser based on phosphate glass fiber," (contributed) *OFC*, Anaheim, CA (March 2006).
259. P. Polynkin, A. Polynkin, D. Panasencko, N. Peyghambarian, M. Mansuripur, J. Moloney, "Watts-level, all-fiber laser at 1.5 μ m mode-locked with a saturable semiconductor absorber," (contributed), *Frontiers in Optics/Laser Science XXI*, OSA annual meeting, Tucson (October 2005).
260. P. Polynkin, A. Polynkin, M. Mansuripur, N. Peyghambarian, "Single-Frequency, Linearly Polarized Fiber Laser with 1.9W Output Power at 1.5 μ m Using Twisted-Mode Technique," (contributed post deadline paper CPDB11) *CLEO*, Baltimore (May 2005).
261. M. Mansuripur, Y. Xie, A. R. Zakharian, J. V. Moloney, "Transmission of light through subwavelength slits and apertures with application to near-field optical recording," (Invited), *Asia Pacific Data Storage Conference (APDSC'06)*, Taiwan, August 2006. Manuscript entitled "Surface plasmon polaritons on metallic surfaces" published in *IEEE Trans. Magnet.* **43**, 845-850 (February 2007).
262. M. Mansuripur, "Future Optical Disk Technologies," (Keynote address), *MediaTech Conference and Showcase*, Long Beach, California, October 2006.
263. M. Mansuripur, "Advances in Optical Data Storage," (Invited) *MediaTech Conference and Showcase*, Barcelona, Spain, March 2007.

264. M. Mansuripur, A. R. Zakharian, and J. V. Moloney, "Radiation pressure and the linear and angular momenta of light in dielectric media," (Invited), *Progress in Electromagnetics Research Symposium (PIERS) 2007*, Beijing, China, March 2007.
265. M. Mansuripur, "Diffraction modeling of optical pickup and media," (contributed), *OSA Topical Meeting on Optical Data Storage*, Portland, Oregon, May 2007.
266. M. Mansuripur, "Macromolecular data storage," (Invited) *Innovative Mass Storage Technologies (IMST)*, Twente University, Amsterdam, The Netherlands, June 2007.
267. M. Mansuripur, "Radiation pressure and the light's linear and angular momenta," (Invited), LATSIS Conference, Ecole Polytechnique Federal Lausanne (EPFL), Switzerland, June 2007.
268. K. Kieu and M. Mansuripur, "Micro-sphere resonator reflector for fiber laser," (contributed), SPIE Conference on Laser Resonators and Beam Control IX, published in *SPIE Proc.* **6452**, 645211 (2007).
269. Y. Xie, A. R. Zakharian, J. V. Moloney, and M. Mansuripur, "Bloch mode analysis of transmission through periodic slit arrays in finite-thickness metallic slabs," (contributed), *SPIE Annual Meeting*, San Diego, California, August 2007.
270. M. Mansuripur, "Radiation pressure on submerged mirrors: implications for the momentum of light in dielectric media," (contributed), *SPIE Annual Meeting*, San Diego, California, August 2007.
271. M. Mansuripur, "The concept of coherence in classical optics," (contributed), Symposium Honoring Professor Joseph W. Goodman, *SPIE Annual Meeting*, San Diego, California, August 2007.
272. M. Mansuripur, "Radiation pressure and the momentum of light in dielectric media," (Invited), Colloquium Series, Electrical Engineering Department, *University of Minnesota*, Minneapolis, September 2007.
273. M. Mansuripur, Y. Xie, A. R. Zakharian, and J. V. Moloney, "Transmission of light through subwavelength slits and apertures," (Invited), *Frontiers in Optics Workshop*, Sao Paulo, Brazil, November 2007. (Supported by OSA's traveling Fellow grant.)
274. M. Mansuripur, "Radiation pressure and the momentum of light in dielectric media," (Invited), College of Engineering, Federal University of Pernambuco, Recife, Brazil, November 2007.
275. M. Mansuripur, "Radiation pressure and the momentum of light in dielectric media," (Invited), *International Workshop on Applied Optics & Nanophotonics*, National Chung Hsing University, Taiwan, November 2007.
276. M. Mansuripur, "Radiation pressure and the linear and angular momenta of the electromagnetic field," (Invited), *Western Pennsylvania OSA Local Section*, April 10, 2008. (Supported by OSA's traveling Fellow grant.)
277. M. Mansuripur, "The Abraham-Minkowski Controversy," (Invited), *Rank Prize Minisymposium: The push or pull of optical momentum?*, London, UK, July 2008.
278. M. Mansuripur, "Can future storage technologies benefit from existing or emerging nano-tools and techniques?" (Keynote address), Joint meeting of the *International Symposium on Optical Memory (ISOM)* and *Optical Data Storage Conference (ODS)*, Hawaii, July 2008.
279. M. Mansuripur, A.R. Zakharian, A. Kobayakov, J.V. Moloney, "Plasmonic nano-structures for optical data storage," (contributed) *Joint ISOM/ODS meeting*, Hawaii, July 2008.
280. M. Mansuripur, "Electromagnetic stress tensor in ponderable media,"(contributed) *SPIE Symp. NanoScience & Engineering*, San Diego, California, August 2008. Published in SPIE

- Proceedings as “Generalized Lorentz law and the force of radiation on magnetic dielectrics,” September 2008.
281. M. Mansuripur, “Can future storage technologies benefit from existing or emerging nano-tools and techniques?” (Invited), *Instrument Technology Research Center*, Taipei, Taiwan, November 21, 2008.
 282. M. Mansuripur, “Radiation pressure and the momentum of light inside dielectrics: The Abraham-Minkowski controversy,” (Invited), *Huazhong University of Science and Technology*, Wuhan, China, November 2008.
 283. M. Mansuripur, “Can future storage technologies benefit from existing or emerging nano-tools and techniques?” (Invited) *8th International Symposium on Optical Storage/2008 International Workshop on Information Data Storage (ISOS/IWIDS 2008)*, Wuhan, China, November 2008.
 284. M. Mansuripur and A. R. Zakharian, “Maxwell's macroscopic equations, the Lorentz law of force, and the nature of electromagnetic momentum,” weekly seminar series at the University of Arizona's Mathematics Department, December 2008.
 285. M. Mansuripur, “Can future storage technologies benefit from existing or emerging nano-tools and techniques?” (Plenary Speaker), *Asia Pacific Data Storage Conference*, Jeju Island, Korea, December 17, 2008.
 286. M. Mansuripur, A. R. Zakharian, A. Kobayakov, and J. V. Moloney, “Plasmonic nano-structures for optical data storage,” (Invited) *CISD Conference (Yonsei University)*, Jeju Island, Korea, December 19, 2008.
 287. M. Mansuripur, A. Zakharian, Sang-Hyun Oh, R. J. Jones, A. Lesuffleur, N. C. Lindquist, Hyungsoon Im, A. Kobayakov, and J. V. Moloney, “Plasmonic optical data storage,” (contributed) *Optical Data Storage Conference*, Lake Buena Vista, Florida, May 2009. Published as “Plasmonic nano-structures for optical data storage,” in *SPIE proceedings*, Fall 2009.
 288. M. Mansuripur, A. Zakharian, Sang-Hyun Oh, R. J. Jones, A. Lesuffleur, N. C. Lindquist, Hyungsoon Im, A. Kobayakov, J. V. Moloney, “Plasmonic Optical Data Storage,” (Invited), *Sir Mark Oliphant Conferences: Nano-photonics Down Under 2009 - Devices and Applications (SMO-NP 2009)*, Melbourne, Australia, June 2009.
 289. M. Mansuripur, “How CD and DVD Players Work,” (Invited), *Nanophotonics Down Under 2009, High School Teachers' Workshop*, Melbourne, Australia, June 2009.
 290. M. Mansuripur, “Macromolecular data storage: What we can learn from Nature's method of information storage in DNA and RNA” (Invited) *Data Storage Institute*, Singapore, June 2009.
 291. M. Mansuripur and A. R. Zakharian, “Whence the Minkowski momentum?” (contributed) *SPIE Symp. Nano-Science & Engineering*, San Diego, California, August 2009.
 292. M. Mansuripur and A. R. Zakharian, “Radiation pressure and photon momentum in negative-index media,” (contributed) *SPIE Symp. Nano-Science & Engineering*, San Diego, California, August 2009.
 293. M. Mansuripur and A. R. Zakharian, “What is wrong with the interpretation of recent nano-filament experiments?” (contributed) *SPIE Symp. Nano-Science & Engineering*, San Diego, California, August 2009.
 294. M. Mansuripur, A. Zakharian, Sang-Hyun Oh, R. J. Jones, A. Lesuffleur, N. C. Lindquist, Hyungsoon Im, A. Kobayakov and J. V. Moloney, “Plasmonic Optical Data Storage,”

- (Invited), *Optical Storage and New Storage Technology (OSNS)*, held in conjunction with Photonics and Opto-Electronics Meetings (POEM), Wuhan, China, August 2009.
295. M. Mansuripur, "Maxwell's macroscopic equations, the energy-momentum postulates, and the Lorentz law of force," (Invited), *Winter School on Plasmonics and Metamaterials*, Sao Carlos University, Brazil, August 10-13, 2009.
 296. M. Mansuripur, "Foundations of the classical Maxwell-Lorentz theory of electrodynamics," (Invited), Campinas University, Brazil, August 14, 2009.
 297. M. Mansuripur, "Can future data storage technologies benefit from the emerging nano-tools and techniques?" Weekly Colloquium Series, Department of Chemical Engineering, University of Arizona, Tucson, October 2009.
 298. M. Mansuripur, A. Zakharian, Sang-Hyun Oh, R. J. Jones, A. Lesuffleur, N. C. Lindquist, Hyungsoon Im, A. Kobayakov, J. V. Moloney, "Plasmonic Optical Data Storage," (Invited), *International Symposium on Optical Memory (ISOM)*, Nagasaki, Japan, October 2009.
 299. M. Mansuripur, "Radiation Pressure, Linear and Angular Momenta of the Electromagnetic Field, and their Applications," (Invited), Hitachi-Maxell Co., Tokyo, Japan, October 2009.
 300. M. Mansuripur, "Electronic/magnetic/optical/molecular information storage, plasmonics, nano-photonics, optical micro-manipulation, and photon momentum," Editorial Board Meeting, *Reports on Progress in Physics*, London, United Kingdom, October 2009.
 301. M. Mansuripur, A. Zakharian, Sang-Hyun Oh, R. J. Jones, A. Lesuffleur, N. C. Lindquist, Hyungsoon Im, A. Kobayakov and J. V. Moloney, "Plasmonic Optical Data Storage," (Invited), *7th International Workshop on Nano-Photonics (NTU_KeioU Nano-Photonics Workshop)*, National Taiwan University, Taipei, March 2010.
 302. M. Mansuripur and A. R. Zakharian, "Energy, momentum, and force in classical electrodynamics: application to negative-index media," (Invited), *Nano-optics, Plasmonics, and Advanced Materials Workshop*, National Institute of Standards and Technology (NIST), Gaithersburg, Maryland, April 2010.
 303. M. Mansuripur, "Macromolecular data storage: What can we learn from Nature's methods of information storage in DNA and RNA molecules?" (Invited), *Yonsei International Symposium: Mechanical Engineering in NT, BT, ET & IT*, Yonsei University, Seoul, Korea, May 2010.
 304. M. Mansuripur and A.R. Zakharian, "Energy, Momentum, Force, and Torque in Classical Electrodynamics: Application to Negative-index Media," (Invited), Weekly Colloquium Series, *National Taiwan University, Physics Department*, May 2010.
 305. M. Mansuripur, "Can future storage technologies benefit from existing or emerging nano-tools and techniques?" (Invited), *National Yunlin University of Science and Technology*, Taichung, Taiwan, May, 2010.
 306. M. Mansuripur and A.R. Zakharian, "Energy, Momentum, Force, and Torque in Classical Electrodynamics: Application to Negative-index Media," (Invited), *Research Center for Applied Sciences, Academia Sinica*, Taipei, Taiwan, June 2010.
 307. M. Mansuripur and A.R. Zakharian, "Energy, Momentum, Force, and Torque in Classical Electrodynamics: Application to Negative-index Media," (Invited), Physics Department, *Shanghai University*, Shanghai, China, June 2010.
 308. M. Mansuripur, A. Zakharian, Sang-Hyun Oh, R. J. Jones, A. Lesuffleur, N. C. Lindquist, Hyungsoon Im, A. Kobayakov and J. V. Moloney, "Plasmonic Optical Data Storage," (Invited), Department of Electronics Engineering, *Huazhong University of Science and Technology*, Wuhan, China, June 2010.

309. M. Mansuripur and A.R. Zakharian, "Energy, Momentum, Force, and Torque in Classical Electrodynamics: Application to Negative-index Media," (Invited), *Monthly meeting of the plasmonics group, Physics Dept., National Taiwan University*, Taipei, Taiwan, June 2010.
310. M. Mansuripur and A.R. Zakharian, "Energy, Momentum, Force, and Torque in Classical Electrodynamics: Application to Negative-Index Media," (Invited), weekly colloquium series, Physics department, Universidade Federal de Pernambuco, Brazil, October 2010.
311. M. Mansuripur, "How CD and DVD players work," (Invited), Workshop on Lasers and Applications, OSA Student Chapter, Recife, Brazil, October 2010.
312. M. Mansuripur, "Photon momentum, optical micro-manipulation, nano-photonics, plasmonics, and electronic/magnetic/optical/molecular information storage," Editorial Board Meeting, *Reports on Progress in Physics*, London, United Kingdom, October 2010.
313. C. M. Chang, C. H. Chu, M. L. Tseng, H-P. Chiang, M. Mansuripur, and D. P. Tsai, "Enhanced electrical conductivity of laser-recorded phase-change marks on sputter-deposited thin films of amorphous $\text{Ge}_2\text{Sb}_2\text{Te}_5$," (contributed), Asia-Pacific Data Storage Conference, Taiwan, November 2010.
314. W. T. Chen, P. C. Wu, C. J. Chen, M. Mansuripur, and D. P. Tsai, "Plasmonic Optical Data Storage," (contributed, winner of the Outstanding Poster Award), Asia-Pacific Data Storage Conference, Taiwan, November 2010.
315. M. Mansuripur, "Solar Sails, Optical Tweezers, and Other Light-Driven Machines," Weekly colloquium series, University of Arizona's Aerospace and Mechanical Engineering Department, February, 2011.
316. M. Mansuripur, "Plasmonic Optical Data Storage," (Invited), Joint special meeting of JSPS Photonic Information Systems and the Magnetics Society of Japan's Opto-functional Magnetic Devices and Materials, Tokyo Garden Palace, Japan, March 2011.
317. M. Mansuripur and A.R. Zakharian, "Diffraction modeling at high numerical aperture," Industrial Affiliates Workshop, *U.A. College of Optical Sciences*, April 2011.
318. M. Mansuripur, "Solar Sails, Optical Tweezers, and Other Light-Driven Machines," (Invited), *MIT Lincoln Laboratory*, Boston, April 2011.
319. M. Mansuripur, "How CD and DVD Players Work," (Invited), IEEE Photonics Society's Photonics Imaging Workshop, Boston, April 2011.
320. M. Mansuripur, "The role of nanotechnology in future data storage devices and systems," (Keynote address), Joint ISOM/ODS conference, Hawaii, July 2011; published in the proceedings of the conference.
321. W.T. Chen, P.C. Wu, C.J. Chen, C.J. Weng, H.C. Lee, T.J. Yen, C.H. Kuan, M. Mansuripur and D.P. Tsai, "Manipulation of multi-dimensional plasmonic spectra for information storage," (contributed), Joint ISOM/ODS conference, Hawaii, July 2011; published in the proceedings of the conference.
322. M.L. Tseng, C.M. Chang, C.H. Chu, M. Mansuripur, and D.P. Tsai, "Physical and chemical characterization of laser-recorded phase-change marks on amorphous $\text{Ge}_2\text{Sb}_2\text{Te}_5$ thin films," (contributed), Joint ISOM/ODS conference, Hawaii, July 2011.
323. M. Mansuripur, A. R. Zakharian and E. M. Wright, "Spin and orbital angular momenta of light reflected from a cone," (Invited), *SPIE Symp. Nano-Science & Engineering*, San Diego, California, August 2011.
324. M. Mansuripur, "Solar Sails, Optical Tweezers, and Other Light-Driven Machines," (Invited), SPIE symposium honoring Professor Joseph W. Goodman's 75th birthday, San

- Diego, California, August 2011; published in *SPIE Proceedings* **8122**, Tribute to Joseph W. Goodman, edited by H. J. Caulfield and H. H. Arsenault, 81220D~1-13 (2011).
325. M. Mansuripur, C. M. Chang, C. H. Chu, M. L. Tseng, H. P. Chiang, and D. P. Tsai, "Local electrical characterization of laser-recorded marks in $\text{Ge}_2\text{Sb}_2\text{Te}_5$ thin films using conductive-tip atomic force microscopy," (Invited), European Symposium on Phase-Change and Ovonic Science (E\PCOS 2011), Zurich, Switzerland, September 2011; published in the conference proceedings.
 326. M. Mansuripur, "The Science and Technology of Nano Materials and Devices," Editorial Board Meeting, *Reports on Progress in Physics*, London, United Kingdom, October 2011.
 327. M. Mansuripur, "Resolution of the Abraham-Minkowski Controversy," (Invited), Boulder Research Seminar on Optical, Electronic and Quantum Systems; joint JILA, Physics, and Electrical Engineering seminar series, University of Colorado at Boulder, November 2011.
 328. M. Mansuripur, W. T. Chen and D. P. Tsai, "High-resolution Readout Schemes in Optical Disk Data Storage," (Invited), *International Symposium on Super-Resolution Imaging*, Shizuoka University, Hamamatsu, Japan, December 2011.
 329. M. Mansuripur, "Solar Sails, Optical Tweezers, and Other Light-Driven Machines," (Invited), colloquium at the department of electrical engineering, Notre Dame University, South Bend, Indiana, January 2012.
 330. M. Mansuripur, "Maxwell's macroscopic equations, energy-momentum postulates, the Lorentz law of force, and interesting connections to Doppler shift," (Invited), *International Photonics Workshop*, University of Sao Carlos, Sao Paulo, Brazil, February 2012.
 331. M. Mansuripur, A. R. Zakharian, "Radiation pressure and photon momentum in negative-index media" (contributed poster), *NanoLight Workshop*, Benasque, Spain, March 2012.
 332. M. Mansuripur, "Energy, Momentum, Force and Torque in Classical Electrodynamics," (Invited), OSA Incubator Meeting, Washington, DC, May 2-4, 2012.
 333. K. Tada, G. A. Cohoon, K. Kieu, M. Mansuripur, and R. A. Norwood, "Fabrication of High-Q Microresonators Using Femtosecond Laser Micromachining," (contributed) Conference on Lasers and Electro-Optics (CLEO), Technical Digest, 2012.
 334. M. Mansuripur, "Energy, Momentum, Force and Torque in Classical Electrodynamics," (Invited), *International Spring School of the Microseres*, Miraflores, Spain, May 2012.
 335. M. Mansuripur, "Solar sails, optical tweezers, and other light-driven machines" (Invited), seminar for summer undergraduate students visiting the College of Optical Sciences, University of Arizona, Tucson, July 2012.
 336. M. Mansuripur, "Trouble with the Lorentz Law of Force: Response to Critics," (contributed) SPIE Annual Meeting, San Diego, California, August 2012.
 337. M. Mansuripur, A. R. Zakharian, "Radiation pressure and photon momentum in negative-index media," (contributed) SPIE Annual Meeting, San Diego, California, August 2012.
 338. M. Mansuripur, "Angular momentum exchange between light and material media deduced from the Doppler shift," (contributed) SPIE Annual Meeting, San Diego, California, August 2012.
 339. M. Mansuripur, "Trouble with the Lorentz law of force: Incompatibility with special relativity and momentum conservation," (Invited) weekly colloquium series, University of Arizona, Physics Department, August 2012.
 340. M. Mansuripur, "Single-photon spectroscopy of single molecules, cavity opto-mechanics, the physics of cancer, optical scissors and tweezers, opto-fluidics, and aerosol studies in an

- optical trap,” editorial board meeting of *Reports on Progress in Physics*, London, United Kingdom, October 2012.
341. M. Mansuripur, A.R. Zakharian and E.M. Wright, “Spin and orbital angular momenta of light reflected from a cone,” (Invited) Industrial Affiliates Meeting, University of Arizona’s College of Optical Sciences, Tucson, October 2012.
 342. M. Mansuripur, “Trouble with the Lorentz law of force: Incompatibility with special relativity and momentum conservation,” (Invited) Physics colloquium, King’s College, London, October 2012.
 343. M. Mansuripur, “Trouble with the Lorentz law of force: Incompatibility with special relativity and momentum conservation,” (Invited) OSA Student Chapter, University of Sao Paulo, Campinas, Brazil, November 2012.
 344. M. Mansuripur, “On the foundational equations of the classical theory of electrodynamics,” (Invited) Latin America Optics and Photonics Conference (LAOP), Sao Sebastiao, Brazil, November 2012.
 345. M. Mansuripur, “Trouble with the Lorentz law of force: Incompatibility with special relativity and momentum conservation,” (Invited) OSA Student Chapter, Karlsruhe Institute of Technology, Karlsruhe, Germany, November 2012.
 346. M. Mansuripur, “On the foundational equations of the classical theory of electrodynamics: Applications to optomechanical sensors and actuators,” (Keynote) *Photonics West Conference*, San Francisco, California, February 2013.
 347. T. S. Mansuripur and M. Mansuripur, “Simulations of light beam incident on a gainy slab elicit mechanism of amplified TIR,” (contributed) *Photonics West Conference*, San Francisco, California, February 2013.
 348. M. Mansuripur, “Mechanical effects of light: radiation pressure, photon momentum, and the Lorentz force law,” (Invited) *Sandia National Laboratories*, Albuquerque, New Mexico, February 2013.
 349. M. Mansuripur, “Trouble with the Lorentz law of force: Incompatibility with special relativity and momentum conservation,” (Invited) weekly colloquium series, department of Physics, *University of New Mexico*, Albuquerque, New Mexico, February 2013.
 350. M. Mansuripur, “Trouble with the Lorentz force law: hidden momentum, Einstein-Laub formula, and the Abraham-Minkowski controversy,” (Invited) Symposium Honoring Prof. Daniel Kleppner, *Sao Carlos Institute of Physics*, Sao Carlos, Brazil, February 2013.
 351. M. Mansuripur, “Mechanical effects of light: radiation pressure, photon momentum, and the Lorentz force law,” (Invited) Department of optics and fine mechanics, *Tsinghua University*, Beijing, China, June 2013.
 352. M. Mansuripur, “Advances in Macromolecular Data Storage,” (Invited) *International Symposium on Photoelectronic Detection and Imaging (ISPD)*, Beijing, China, June 2013.
 353. M. Mansuripur, “Trouble with the Lorentz force law: hidden momentum, Einstein-Laub formula, and the Abraham-Minkowski controversy,” (Invited) *International Symposium on Advanced Magnetic Materials and Applications (ISAMMA)*, Taichung, Taiwan, July 2013.
 354. M. Mansuripur, “Mechanical effects of light: radiation pressure, photon momentum, and the Lorentz force law,” (Invited) Research Center for Applied Sciences, *Academia Sinica*, Taipei, Taiwan (July 2013).
 355. M. Mansuripur, A.R. Zakharian, and E.M. Wright, “Electromagnetic field and force distribution inside matter,” (contributed) *SPIE Annual Meeting*, San Diego, California, August 2013.

356. M. Mansuripur, "The Lorentz force law and its connections to hidden momentum, the Einstein-Laub force, and the Aharonov-Casher effect," (Invited) *SPIE Annual Meeting*, San Diego, California, August 2013.
357. M. Mansuripur, "Mechanical effects of light: radiation pressure, photon momentum, and the Lorentz force law," (Invited) Department of Optoelectronic Engineering, *JiNan University*, GuangZhou, China, November 2013.
358. M. Mansuripur, "Advances in Macromolecular Data Storage," (Invited) *Asia-Pacific Data Storage Conference (APDSC'13)*, Hualien, Taiwan, November 2013.
359. Z. Zhu, T. Mankowski, K. Balakrishnan, F. Touati, M. A. Benammar, M. Mansuripur, and C. M. Falco, "Hybrid thin-films of Graphene materials and metallic nanowires for next generation transparent electrodes," (contributed poster) Renewable Energy and the Environment Congress, *Optical Society of America*, Tucson, Arizona (November 2013).
360. C. M. Falco, M. Mansuripur, Z. Zhu, K. Balakrishnan, and T. Mankowski, "High Performance Transparent Nanowire Electrodes for Solar Cells," (Invited) IEEE-GCC Conference, Doha, Qatar (November 2013).
361. M. Mansuripur, "On the Electrodynamics of Moving Permanent Dipoles in External Electromagnetic Fields," (contributed), Metamaterials Conference, SPIE Annual Meeting, San Diego, California (August 2014).
362. M. Mansuripur, "Advances in Macromolecular Data Storage," (Invited), *SPIE Symposium on Optical Data Storage*, San Diego, California (August 2014).
363. M. Mansuripur, "Mechanical Effects of Light on Material Media: Radiation Pressure and the Linear and Angular Momenta of Photons," (Invited), 50th Anniversary of the College of Optical Sciences, *SPIE Optics & Photonics*, San Diego, California (August 2014).
364. M. Mansuripur, "Electromagnetic force and torque in Lorentz and Einstein-Laub formulations," (contributed), Optical Trapping and Optical Micromanipulation XI, *SPIE Annual Meeting*, San Diego, California (August 2014).
365. M. Mansuripur, "The Charge-Magnet Paradoxes of Classical Electrodynamics," (Invited) Spintronics VII, *SPIE Annual Meeting*, San Diego, California (August 2014).
366. Z. Zhu, T. Mankowski, K. Balakrishnan, F. Touati, M. A. Benammar, M. Mansuripur, and C. M. Falco, "Transparent conducting electrodes based on narrow, ultra-long copper nanowires and graphene nanocomposites," (contributed), *SPIE Annual Meeting*, San Diego, California (August 2014).
367. T. S. Mankowski, Z. Zhu, K. Balakrishnan, F. Touati, M. A. Benammar, M. Mansuripur and C. M. Falco, "Metal nanowire-graphene composite transparent electrodes," (contributed), *SPIE Annual Meeting*, San Diego, California (August 2014).
368. M. Mansuripur, "Mechanical Effects of Light: Radiation Pressure, Photon Momentum, and the Lorentz Force Law," (Invited), *2nd International Conference and Exhibition on Lasers, Optics & Photonics*, Philadelphia, Pennsylvania (September 2014).
369. M. Mansuripur, "Mechanical Effects of Light: Radiation Pressure, Photon Momentum, and the Lorentz Force Law," (Invited), Seminar in the College of Engineering, *University of Pennsylvania*, Philadelphia (September 2014).
370. M. Mansuripur, "The Force Law of Classical Electrodynamics: Lorentz versus Einstein and Laub," (Invited) Symposium on the 50th Anniversary of the College of Optical Sciences, *OSA Annual Meeting*, Tucson (October 2014).

371. M. Mansuripur, "Mechanical Effects of Light: Radiation Pressure, Photon Momentum, and the Lorentz Force Law," Weekly Colloquium Series, *College of Optical Sciences, University of Arizona*, Tucson (October 2014).
372. M. Mansuripur, "Mechanical Effects of Light: Radiation Pressure, Photon Momentum, and the Lorentz Force Law," (Invited), Weekly Colloquium Series, Department of Physics, *San Jose State University*, San Jose, California (October 2014).
373. M. Mansuripur, "Advances in Macromolecular Data Storage," (Invited), Seminar in the College of Engineering, *Qatar University*, Doha, Qatar (October 2014).
374. M. Mansuripur, "Mechanical Effects of Light on Material Media: Radiation Pressure and the Linear and Angular Momenta of Photons," (Invited) Seminar in the School of Mathematical & Statistical Sciences, *Arizona State University*, Tempe (November 2014).
375. M. Mansuripur, "Advances in Macromolecular Data Storage," (Invited) Seminar in the School of Mathematical & Statistical Sciences, *Arizona State University* (November 2014).
376. M. Mansuripur, "Electric and magnetic dipoles in the Lorentz and Einstein-Laub formulations of classical electrodynamics," (Invited), *SPIE Photonics West*, San Francisco, California (February 2015).
377. M. Mansuripur, "Advances in Macromolecular Data Storage," (Invited) Biophotonics Symposium, *SPIE Annual Meeting*, San Diego, California (August 2015).
378. M. Mansuripur, "Energy and Linear and Angular Momenta in Simple Electromagnetic Systems," (contributed), Optical Trapping and Optical Micromanipulation XII, *SPIE Annual Meeting*, San Diego, California (August 2015).
379. M. Mansuripur, "Simple explanation of opto-mechanical cooling by the back action of cavity photons," (contributed), presented at the Optical Trapping and Optical Micro-manipulation XII, *SPIE Annual Meeting*, San Diego, California (August 2015).
380. G. Spavieri and M. Mansuripur, "Origin of the Spin-Orbit Interaction," (Invited), presented at Spintronics VIII, *SPIE Annual Meeting*, San Diego, California (August 2015).
381. Z. Zhu, T. Mankowski, K. Balakrishnan, A.S. Shikoh, F. Touati, M.A. Benammar, M. Mansuripur and C.M. Falco, "Fabrication of aluminum-doped zinc oxide transparent conductive electrodes using plasma treatment for solar cell applications," (contributed), *SPIE Annual Meeting*, San Diego, California (August 2015).
382. M. Mansuripur, "Principles of Macromolecular Data Storage," (Invited) *IBM Research & Development Group*, Tucson, Arizona (September 2015).
383. M. Mansuripur, "Advances in Macromolecular Data Storage," (Invited), *International Symposium on Optical Memory (ISOM)*, Toyama, Japan (October 2015).
384. M. Mansuripur, "How CD and DVD Players Work," (Invited) *Jinan University*, Guangzhou, People's Republic of China (October 2015).
385. M. Mansuripur, "Advances in Macromolecular Data Storage," (Invited), *Jinan University*, Guangzhou, People's Republic of China (October 2015).
386. M. Mansuripur, "How CD and DVD Players Work," (Invited) *Qatar University*, Doha, Qatar (November 2015).
387. M. Mansuripur, "Principles of Macromolecular Data Storage," (Invited), *Department of Management Information Systems*, University of Arizona, Tucson (January 2016).
388. M. Mansuripur, "Light-matter interaction: Conversion of optical energy and momentum to mechanical vibrations and phonons," (Invited) *SPIE Photonics West Symposium*, San Francisco, California (February 2016).

389. M. Mansuripur, M. Kolesik, and P. Jakobsen, "Spin and orbital angular momenta of trapped electromagnetic fields in leaky optical cavities," (Invited), *SPIE Optics & Photonics Symposium*, San Diego, California (August 2016).
390. M. Mansuripur, "Electromagnetic angular momentum in cylindrically-symmetric and spherically-symmetric systems," (contributed), *SPIE Optics & Photonics Symposium*, San Diego, California (August 2016).
391. M. Mansuripur, "Momentum exchange between photons and phonons in structured media," (contributed), *SPIE Optics & Photonics Symposium*, San Diego, California (August 2016).
392. Z. Zhu, T. Mankowski, K. Balakrishnan, A. S. Shikoh, F. Touati, M. A. Benammar, M. Mansuripur and C. M. Falco, "A new hybrid transparent conductive electrode based on copper nanowires and its application in solar cells," (contributed), *Thin Films for Solar and Energy Technology VIII, SPIE Optics & Photonics Symposium*, San Diego, California (August 2016).
393. M. Mansuripur, "Field Momentum and Structured Light," (Invited) *Workshop on Quantum Field Framework for Structured Light Interactions*, Banff International Research Station (BIRS), April 2017.
394. M. Mansuripur, "Optical Angular Momentum in Classical Electrodynamics," (Invited) presented at the 11th *Asia-Pacific Conference on Near-field Optics (APNFO)*, Tainan, Taiwan (July 2017).
395. M. Mansuripur, "Thermodynamics of Radiation Pressure and Photon Momentum," (Invited), Academia Sinica, Taipei, Taiwan (July 2017).
396. M. Mansuripur, "Angular Momentum Exchange Between Light and Small Particles," (contributed) presented at *SPIE Optics & Photonics Symposium*, San Diego, California (August 2017).
397. M. Mansuripur and Pin Han, "Thermodynamics of Radiation Pressure and Photon Momentum," (contributed) presented at *SPIE Optics & Photonics Symposium*, San Diego, California (August 2017).
398. M. Mansuripur, "Nature of the electromagnetic force between classical magnetic dipoles," (Invited) presented at *SPIE Optics & Photonics Symposium*, San Diego, California (August 2017).
399. M. Mansuripur, "Mechanical Effects of Light: Radiation Pressure, Photon Momentum, and the Lorentz Force Law," (Invited) University of Ottawa's Weekly Colloquium Series, Ottawa, Canada (October 2017).
400. M. Mansuripur, "Thermodynamics of radiation pressure and photon momentum," (Invited) University of Ottawa, Canada (October 2017).
401. M. Mansuripur, "Principles of Macromolecular Data Storage," (Invited) University of New Mexico's Weekly Colloquium Series, Albuquerque, New Mexico (November 2017).
402. M. Mansuripur, "Thermodynamics of radiation pressure and photon momentum," (Invited) University of New Mexico, Albuquerque, New Mexico (November 2017).
403. M. Mansuripur, "Thermodynamics of Radiation Pressure and Photon Momentum (Part 2)," (Invited) *SPIE Photonics West Symposium*, San Francisco, California (January 2018).
404. M. Mansuripur, "Energy, linear momentum, and angular momentum exchange between an electromagnetic wave-packet and a small particle," (contributed) *SPIE Structured Light 2018 Conference*, Yokohama, Japan. (Extended abstract published in *SPIE Proceedings 10712*, Optical Manipulation Conference, 107121E~1-3 (2018); doi: 10.1117/12.2317336.)

405. M. Mansuripur, "Fourier Optics in the Classroom," (Invited) Imaging & Applied Optics Congress, Optical Society of America, Orlando, Florida (June 2018).
406. M. Mansuripur, "Energy, linear momentum, and angular momentum exchange between an electromagnetic wave-packet and a small particle," (contributed) *SPIE Optics & Photonics*, San Diego, California (August 2018).
407. M. Mansuripur, "Spin and orbital angular momenta of an electromagnetic wave-packet," (Invited) *SPIE Optics & Photonics*, San Diego, California (August 2018).
408. M. Mansuripur, "Mechanical effects of light: Radiation pressure, photon momentum, and the Lorentz force law," (Invited) *Xi'an Institute of Optics & Precision Mechanics*, Chinese Academy of Sciences (October 2018).
409. M. Mansuripur, "Mechanical effects of light: Radiation pressure, photon momentum, and the Lorentz force law," (Invited) *Xi'an Jiao Tong University* (October 2018).
410. M. Mansuripur, "Thermodynamics of radiation pressure and photon momentum," (Invited) International Symposium on Imaging, Sensing, and Optical Memory (ISOM), Kitakyushu, Japan (October 2018).
411. M. Mansuripur, "Self-field and the radiated energy and linear momentum of an accelerated point charge," (Invited) *SPIE Photonics West*, San Francisco, California (February 2019).
412. M. Mansuripur, "Self-field, radiated energy, and radiated linear momentum of an accelerated point charge," (Invited) *OSA Biophotonics Conference: Optics in the Life Sciences*, Tucson, Arizona (April 2019).
413. M. Mansuripur, "Self-field, radiated energy, and radiated linear momentum of an accelerated point charge," (Invited) *Discussions on Nano & Mesoscopic Optics* (DINAMO), Isla San Cristobal, Galápagos, Ecuador (April 2019).
414. M. Mansuripur and P. K. Jakobsen, "On the nature of the Sommerfeld-Brillouin forerunners (or precursors)" (Invited) *Superoscillations: Theoretical Aspects and Applications*, Cetraro, Italy (June 2019).
415. M. Mansuripur, "How and why an isotropic transparent particle picks up linear momentum but not spin angular momentum from a light beam," (Invited) *5th International Conference on Optical Angular Momentum* (ICOAM 19), Ottawa, Canada (June 2019).
416. M. Mansuripur, "Why isotropic transparent particles pick up linear momentum but not spin angular momentum from a light beam," (contributed) *SPIE Optics & Photonics*, San Diego, California (August 2019).
417. M. Mansuripur, "Spin-orbit coupling in the hydrogen atom, the Thomas precession, and the exact solution of Dirac's equation," (Invited) *SPIE Optics & Photonics*, San Diego, California (August 2019).
418. M. Mansuripur, "Mechanical effects of light: Radiation pressure, photon momentum, and the Abraham-Minkowski controversy," (Invited Colloquium) School of Engineering and Applied Sciences, Harvard University (September 2019).
419. M. Mansuripur, "Dispersion of electromagnetic waves in linear, homogeneous, and isotropic media," (contributed) *SPIE Optics & Photonics* (Memorial Symposium honoring Roland V. Shack), San Diego, California (August 2020).
420. M. Mansuripur, "Energy, linear momentum, and spin and orbital angular momenta of circularly polarized Laguerre-Gaussian wave-packets," (contributed) *SPIE Optics & Photonics*, San Diego, California (August 2020).

421. M. Mansuripur and P. K. Jakobsen, "Electromagnetic radiation and the self field of a spherical dipole oscillator," (Invited) *SPIE Optics & Photonics*, San Diego, California (August 2020).
422. M. Mansuripur, "An exact derivation of the Thomas precession rate using the Lorentz transformation," (Invited) *SPIE Optics & Photonics*, San Diego, California (August 2020).
423. M. Mansuripur and P. K. Jakobsen, "On the problem of total internal reflection from finite and semi-infinite gain media," (Invited) *International Symposium on Imaging, Sensing, and Optical Memory*, Takamatsu, Japan (December 2020).
424. M. Mansuripur, "Mechanical effects of light: Radiation pressure, photon momentum, and the Abraham-Minkowski controversy," (Invited) *Colloquiums on the Occasion of the International Day of Light, Optics & Photonics Society of Iran* (May 2021).
425. M. Mansuripur and P. K. Jakobsen, "Fresnel reflection and transmission in the presence of gain media," (Invited) *SPIE Optics & Photonics*, San Diego, California (August 2021).
426. M. Mansuripur, "Electromagnetic force and torque derived from a Lagrangian in conjunction with the Maxwell-Lorentz equations," (Contributed) *SPIE Optics & Photonics*, San Diego, California (August 2021).
427. M. Mansuripur, "Ubiquity of Fourier transformation in optical sciences," (contributed) *SPIE Symposium Honoring Prof. James C. Wyant*, San Diego, California (August 2021).
428. M. Mansuripur, "Spin-1 photons, spin- $\frac{1}{2}$ electrons, Bell's inequalities, and Feynman's special perspective on quantum mechanics," (Invited) *SPIE Optics & Photonics*, San Diego, California (August 2022).
429. M. Mansuripur, "Linear and angular momenta of photons in the context of 'which path' experiments of quantum mechanics," (contributed) *SPIE Optics & Photonics*, San Diego, California (August 2022).
430. M. Mansuripur, "Insights into the behavior of certain optical systems gleaned from Feynman's approach to quantum electrodynamics," (Invited) *SPIE Optics & Photonics*, San Diego, California (August 2022).
431. M. Mansuripur, "Electromagnetic angular momentum of quantized wavepackets in free space," (contributed), to be presented at the *SPIE Optics & Photonics*, San Diego, California (August 2023).
432. M. Mansuripur, "Spin and orbital angular momenta of electromagnetic waves in classical and quantum electrodynamics," (Invited), to be presented at the *SPIE Optics & Photonics*, San Diego, California (August 2023).
433. M. Mansuripur, "A comparison of the classical and quantum theories of light interacting with nano-materials," (Invited), to be presented at the *SPIE Optics & Photonics*, San Diego, California (August 2023).

Short Courses

1. M. Mansuripur, "Principles of optical disk data storage," Data General Corporation, Boston, Massachusetts, 1983.
2. M. Mansuripur, "Principles of optical disk data storage," IBM Corporation, General Products Division, Tucson, Arizona, 1986.
3. M. Mansuripur, "Optical disk data storage technology," SPIE, San Jose, California, April 1992
4. M. Mansuripur, "Technology of optical disk data storage," SPIE, San Jose, California, April 1993

5. M. Mansuripur, "Principles and techniques of optical disk data storage," Eastman Kodak Company, Rochester, New York, January 1993.
6. M. Mansuripur, "Principles of optical disk data storage," Samsung Electronics, Suwon City, Korea, May 1993.
7. M. Mansuripur, "Principles of magneto-optical disk data storage," CLEO/Pacific Rim Chiba, Japan, July 1995.
8. M. Mansuripur, "Optical simulations with DIFFRACT," Toyota Institute of Technology, Nagoya, Japan, July 1997.
9. M. Mansuripur, "Fundamentals of magnetic and optical data storage," Asia-Pacific Data Storage Conference, Taiwan, July 1997.
10. M. Mansuripur, "Principles of optical disk data storage," TeraStor Corporation, San Jose, California, September 1997.
11. M. Mansuripur, "Principles of optical disk data storage," Quantum Corporation, Part I: Shrewsbury, Massachusetts, Part II: Milpitas, California, June 1998.
12. M. Mansuripur, "Magneto-optical head design," SPIE's Photonics West Conference, San Jose, California, January 1999.
13. M. Mansuripur, "Magneto-optical head design," SPIE's 44th annual meeting, Denver, Colorado, July 1999.
14. M. Mansuripur, "Principles of Optical Disk Data Storage," Winter College on Optics and Photonics, *The Abdus Salam International Center for Theoretical Physics*, Trieste, Italy, February 2000.
15. M. Mansuripur, "Principles of Optical Disk Data Storage," *International Summer College on Optics and Photonics (ISCOP)*, Center for Applied Physics and Astronomical Research, Tabriz University, Iran, August 2001.
16. M. Mansuripur, "Limitations imposed by signal and noise in optical data storage," *Optical Data Storage Conference*, Santa Fe, New Mexico, April 2001.
17. M. Mansuripur, "Optical Recording Status and Prospective," *International Symposium on Optical Memory (ISOM'01)*, Taipei, Taiwan, October 2001.
18. M. Mansuripur, "Advanced Media Technologies," *Optical Data Storage Conference*, Portland, Oregon, May 2007.
19. M. Mansuripur, "Can future storage technologies benefit from existing or emerging nano-tools and techniques?" Tutorial session, *Optical Data Storage Conference*, Lake Buena Vista, Florida, May 2009.
20. M. Mansuripur, "Mathematical Methods in Science and Engineering: Applications in Optics and Photonics," Summer School for Talent Undergraduate Students at the *Xi'an Jiao Tong University*, Xi'an, People's Republic of China (July 1-12, 2019).
21. M. Mansuripur, "Fundamental Principles of the Classical Maxwell-Lorentz Theory of Electrodynamics," Summer School for Talent Undergraduate Students at the *Xi'an Jiao Tong University*, Xi'an, People's Republic of China (July 3-14, 2023).